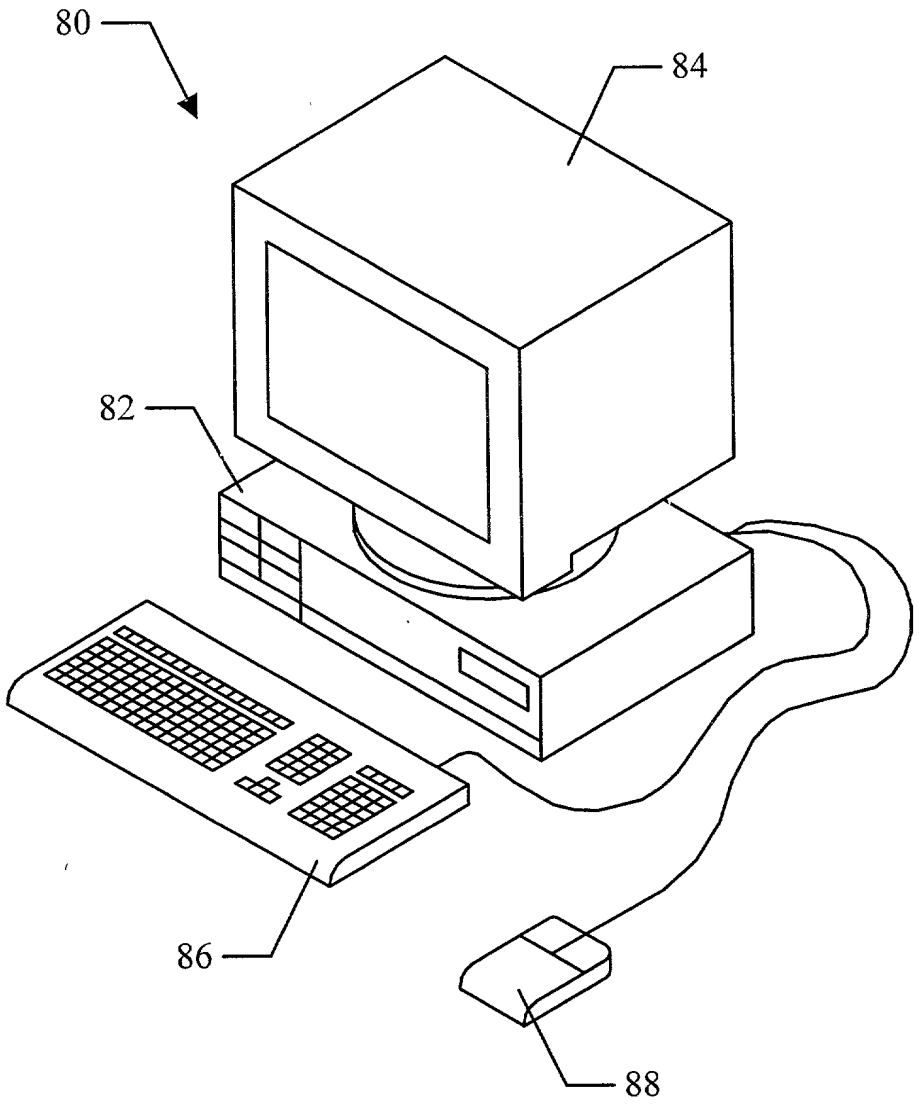


FIG. 1

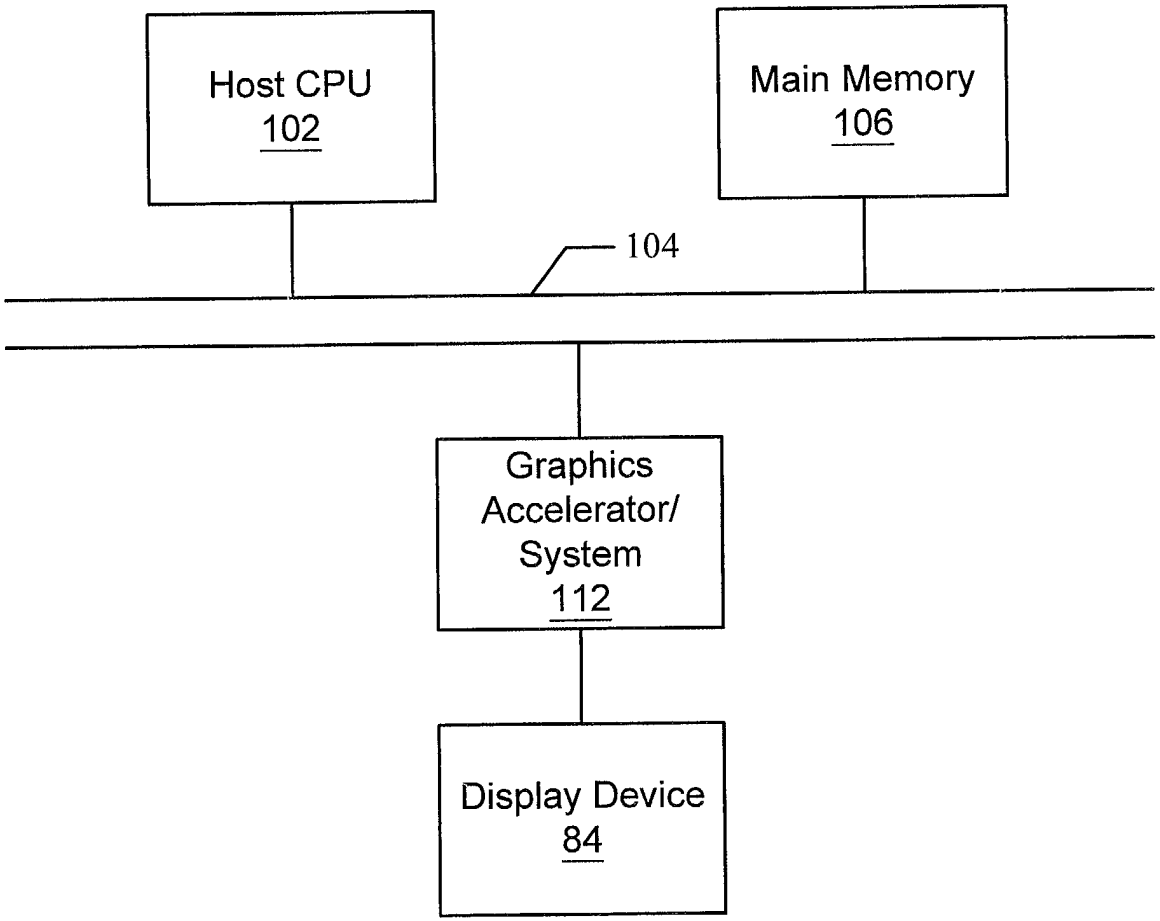


FIG. 2

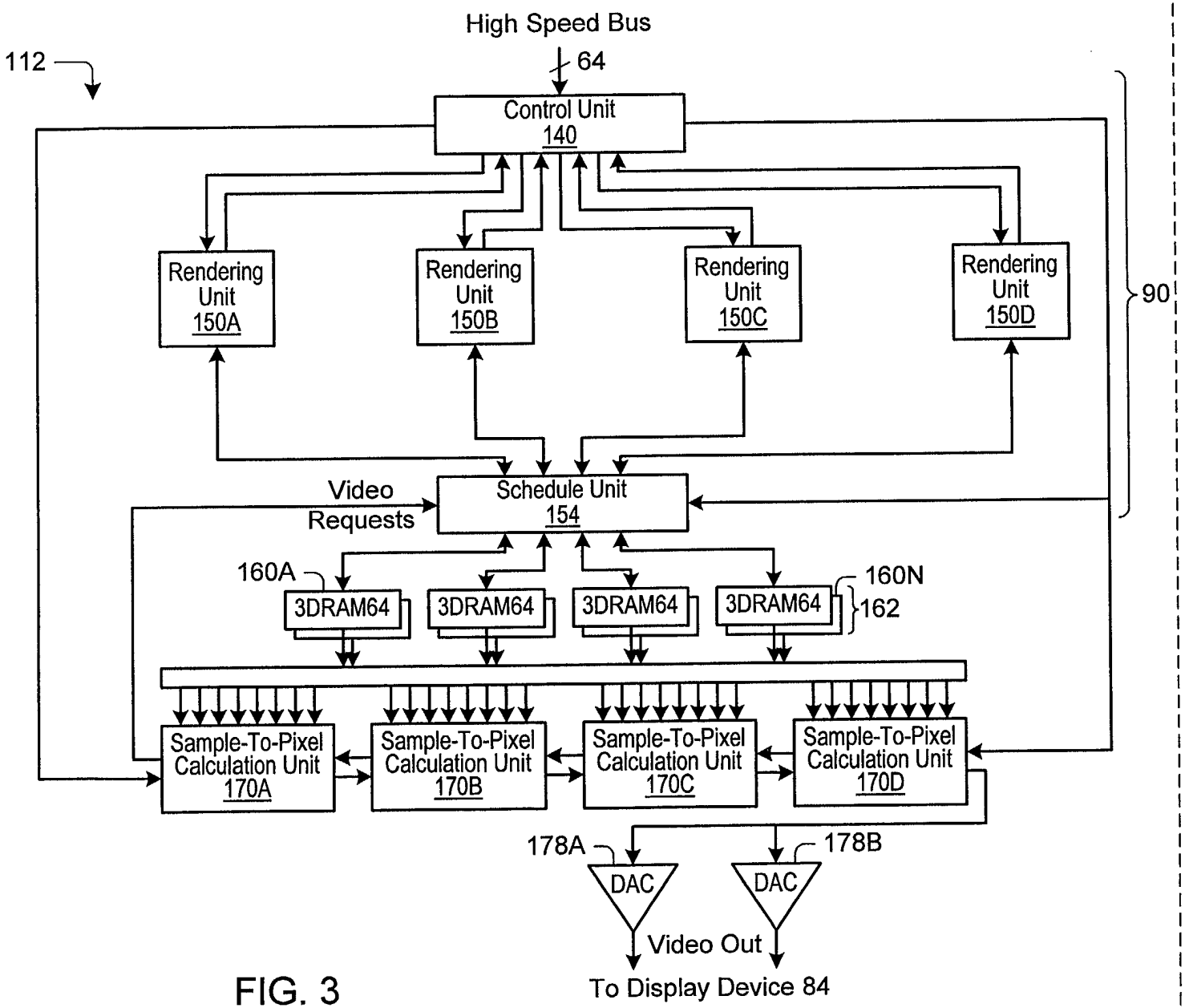


FIG. 3

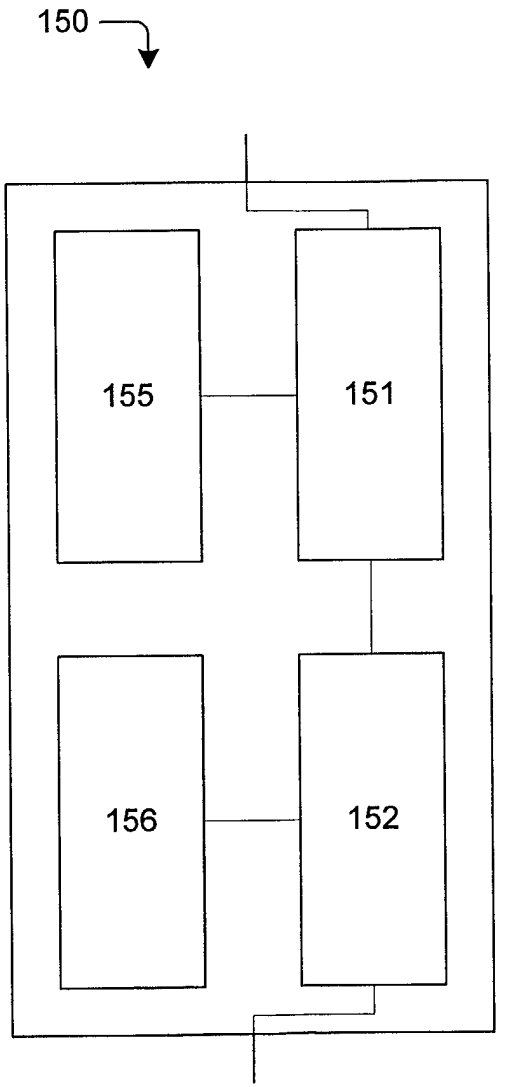


FIG. 3A

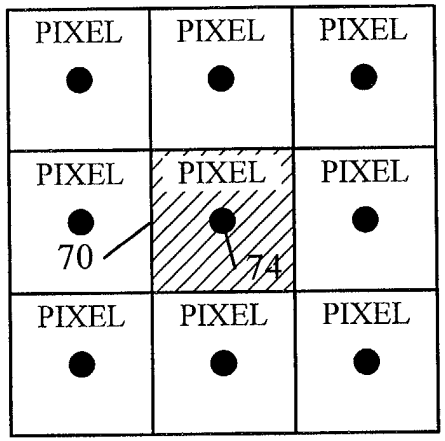


FIG. 4

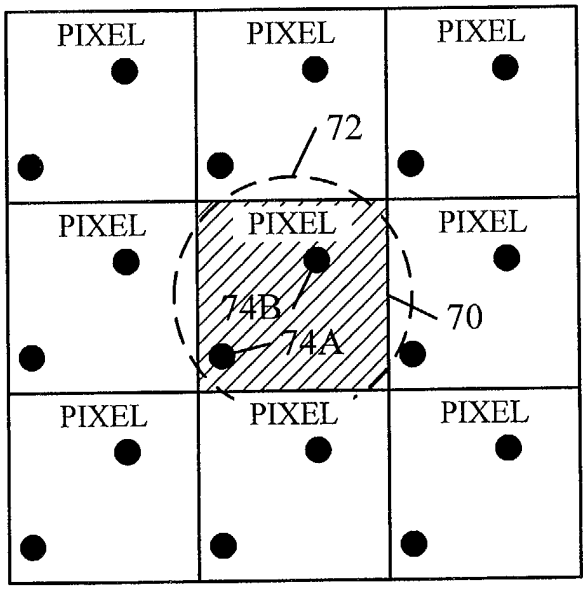


FIG. 5A

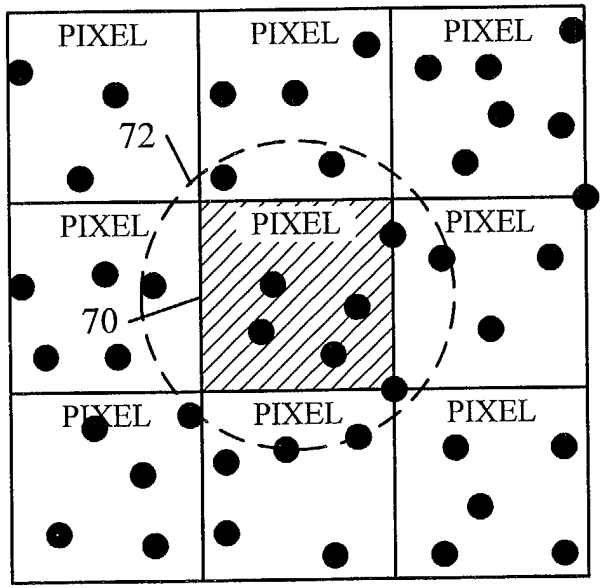


FIG. 5B

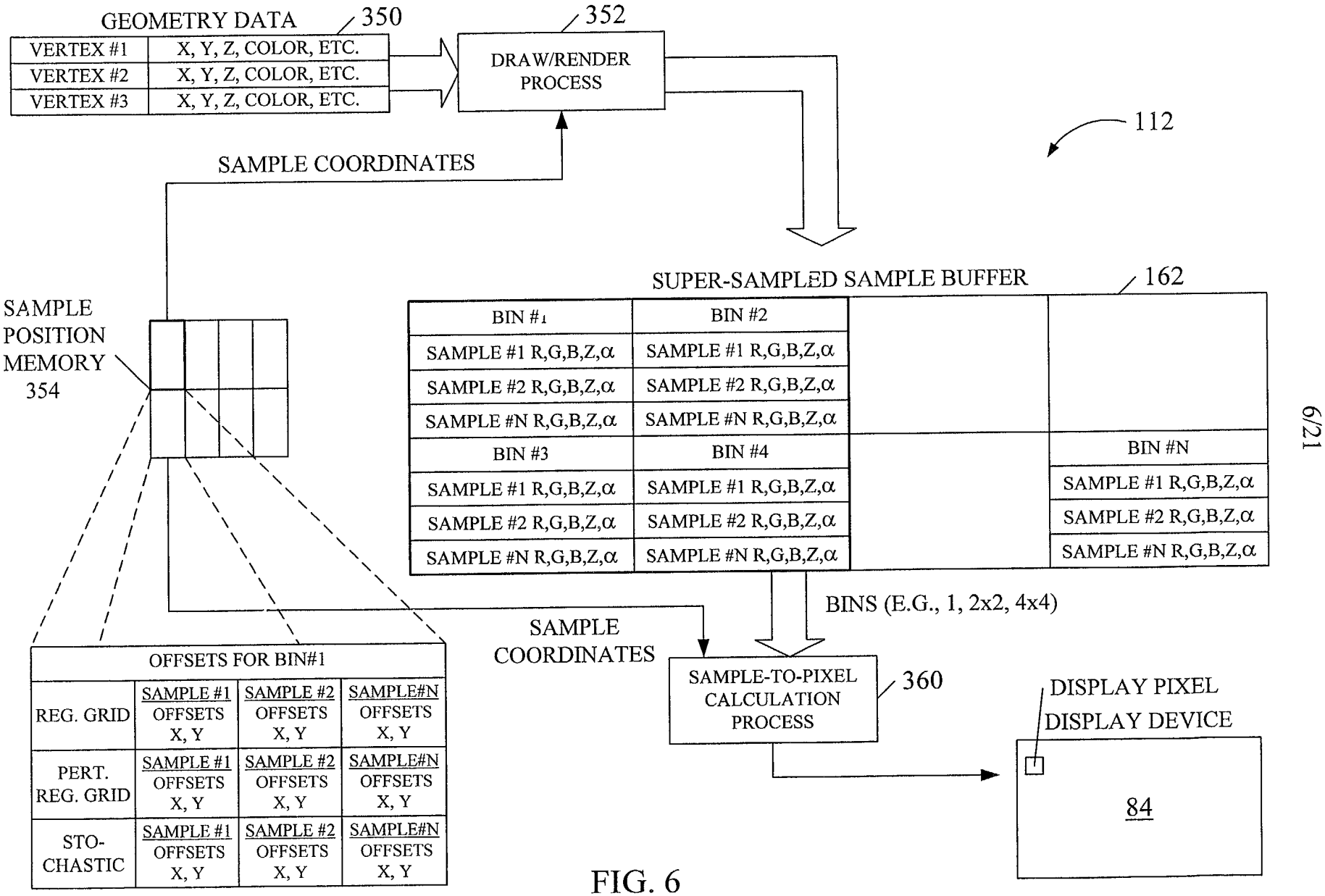

GEOMETRY DATA
350
VERTEX #1
X, Y, Z, COLOR, ETC.
VERTEX #2
X, Y, Z, COLOR, ETC.
VERTEX #3
X, Y, Z, COLOR, ETC.
352
DRAW/RENDER PROCESS
112
SAMPLE COORDINATES
SUPER-SAMPLED SAMPLE BUFFER
162
SAMPLE POSITION MEMORY 354
BIN #1
BIN #2
SAMPLE #1 R,G,B,Z,α
SAMPLE #2 R,G,B,Z,α
SAMPLE #N R,G,B,Z,α
BIN #3
BIN #4
BIN #N
BINS (E.G., 1, 2x2, 4x4)
SAMPLE COORDINATES
SAMPLE-TO-PIXEL CALCULATION PROCESS
360
DISPLAY PIXEL
DISPLAY DEVICE
84
OFFSETS FOR BIN#1
REG. GRID
PERT. REG. GRID
STO-CHASTIC
SAMPLE #1 OFFSETS X, Y
SAMPLE #2 OFFSETS X, Y
SAMPLE#N OFFSETS X, Y

FIG. 6

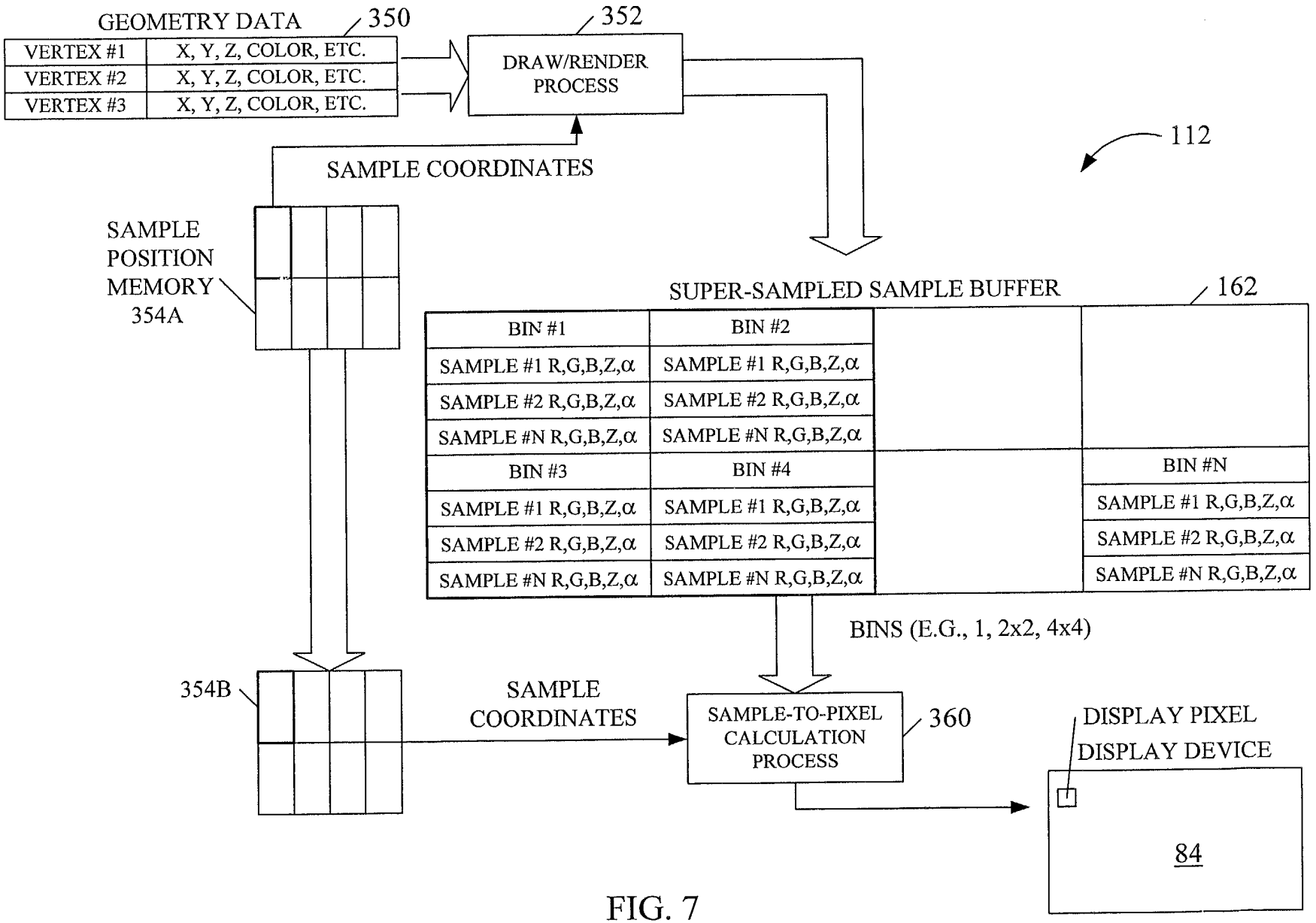
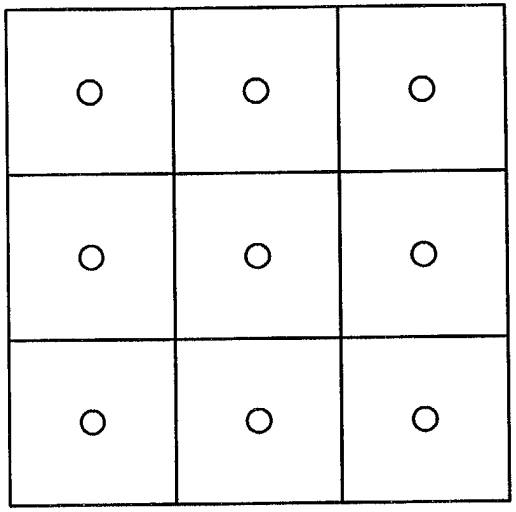
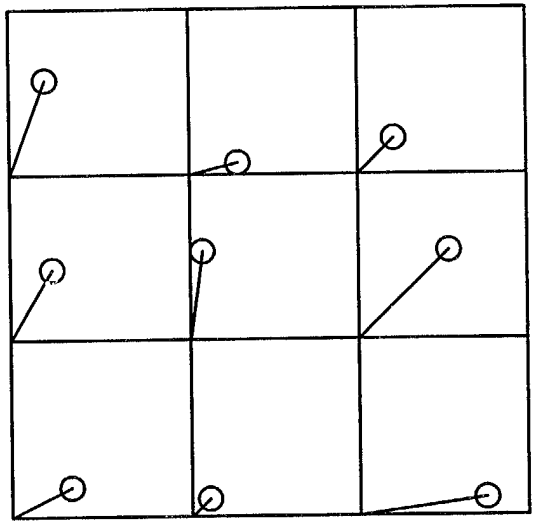

GEOMETRY DATA
350
VERTEX #1
X, Y, Z, COLOR, ETC.
VERTEX #2
X, Y, Z, COLOR, ETC.
VERTEX #3
X, Y, Z, COLOR, ETC.
352
DRAW/RENDER PROCESS
112
SAMPLE COORDINATES
SAMPLE POSITION MEMORY 354A
SUPER-SAMPLED SAMPLE BUFFER
162
BIN #1
BIN #2
SAMPLE #1 R,G,B,Z,α
SAMPLE #2 R,G,B,Z,α
SAMPLE #N R,G,B,Z,α
BIN #3
BIN #4
BIN #N
BINS (E.G., 1, 2x2, 4x4)
354B
SAMPLE COORDINATES
SAMPLE-TO-PIXEL CALCULATION PROCESS
360
DISPLAY PIXEL
DISPLAY DEVICE
84

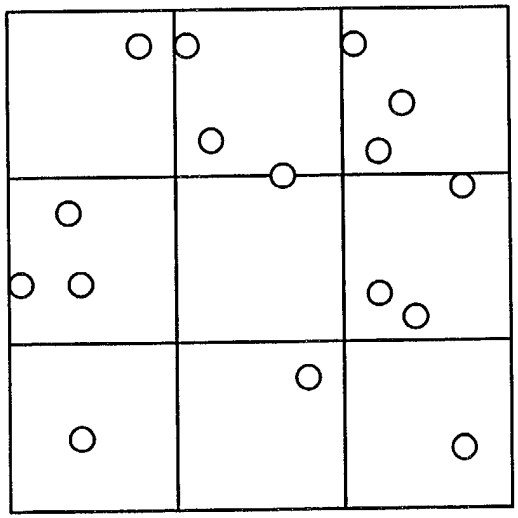
FIG. 7



REGULAR GRID 190



192 PERTURBED REGULAR GRID



194 STOCHASTIC SPACING

FIG. 8

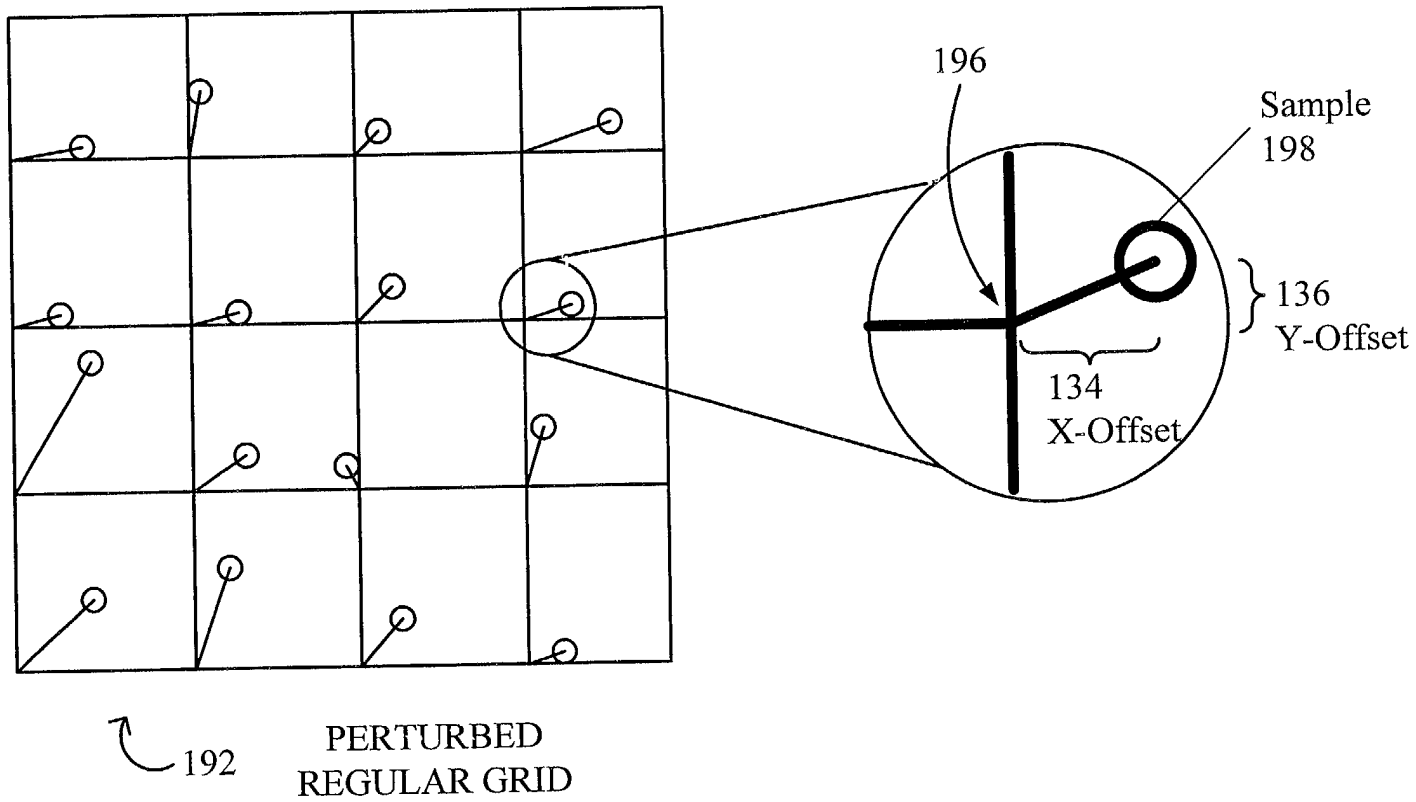


FIG. 9

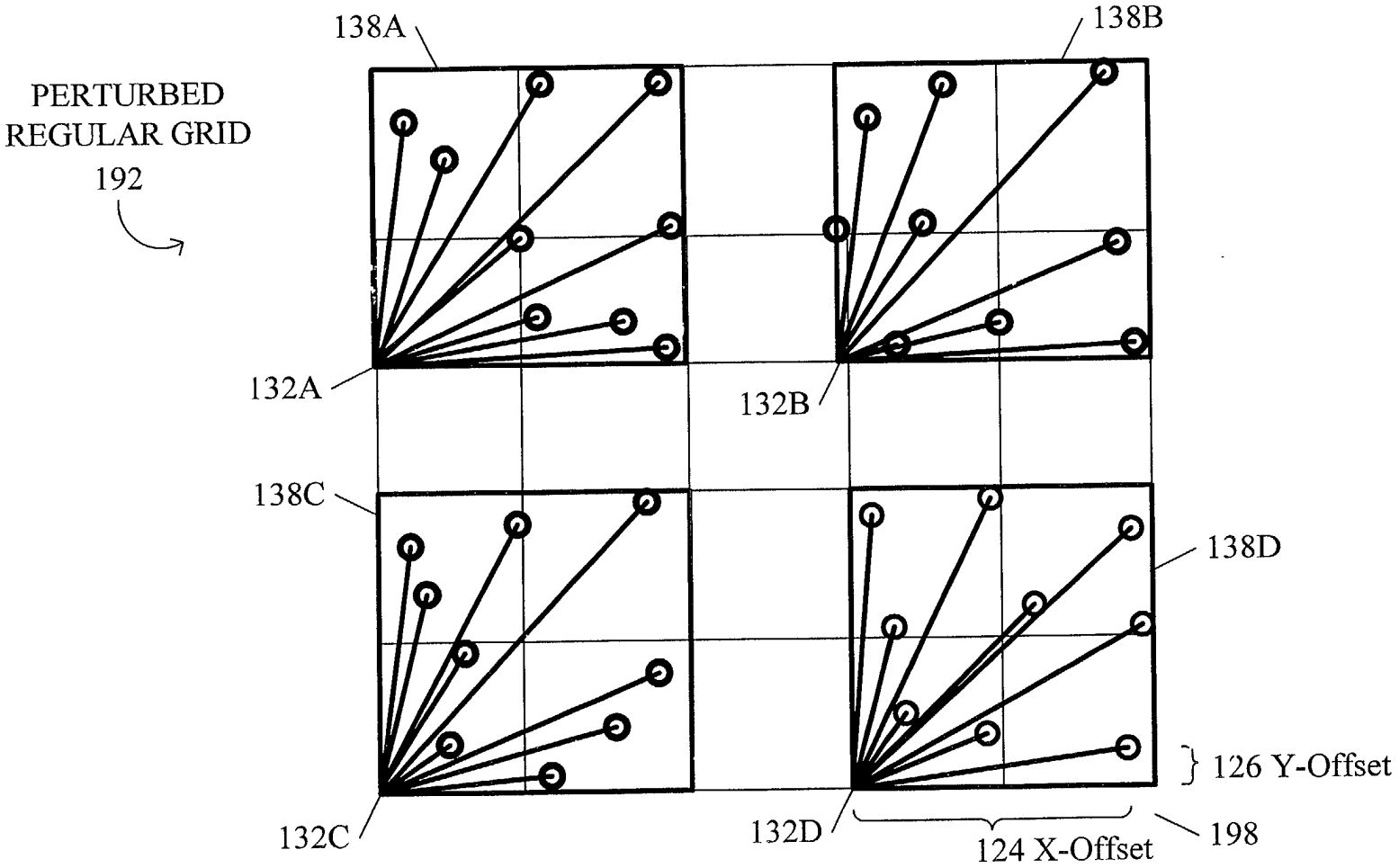

PERTURBED
REGULAR GRID
192
138A
138B
132A
132B
138C
138D
126 Y-Offset
132C
132D
124 X-Offset
198

FIG. 10

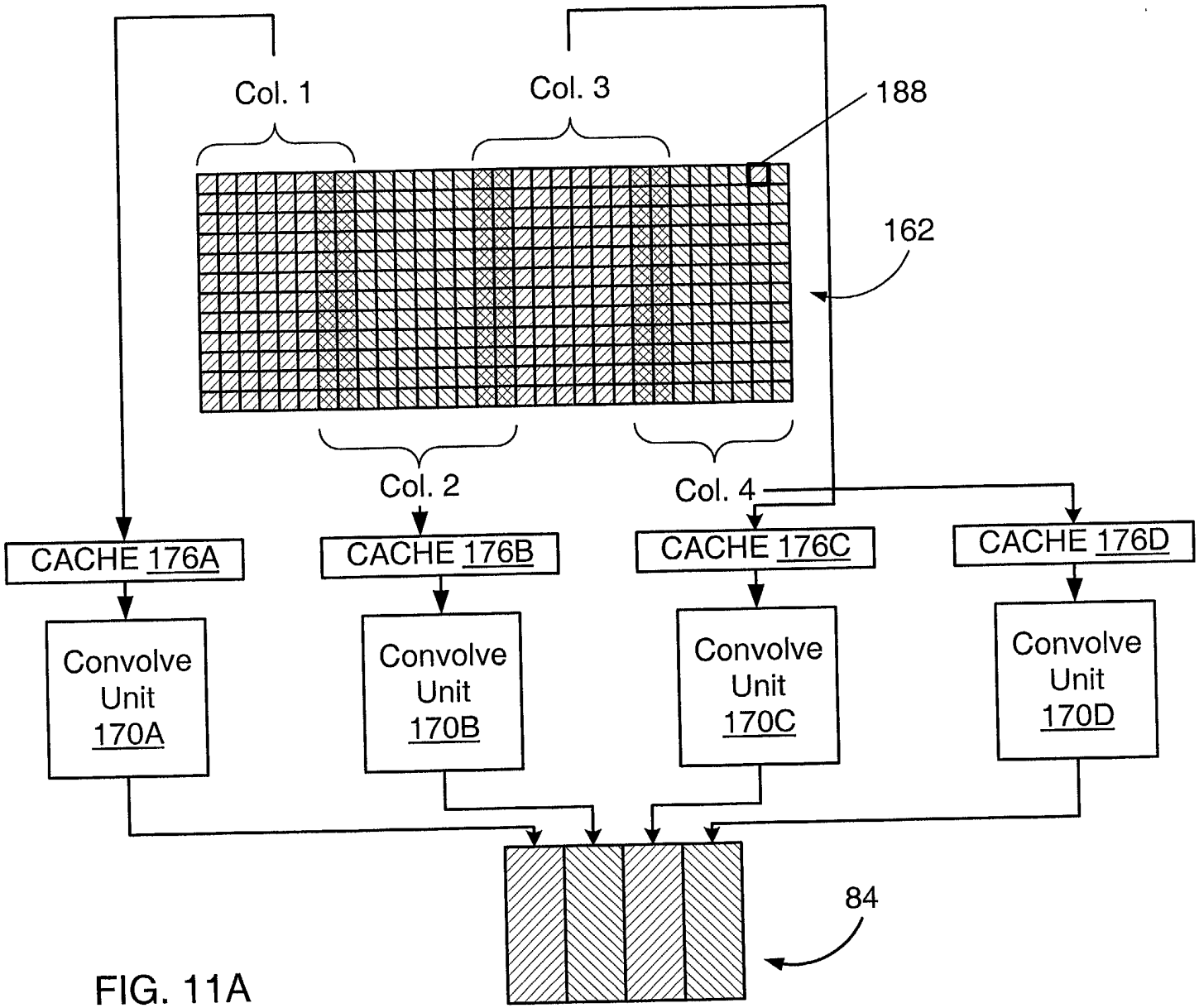


FIG. 11A

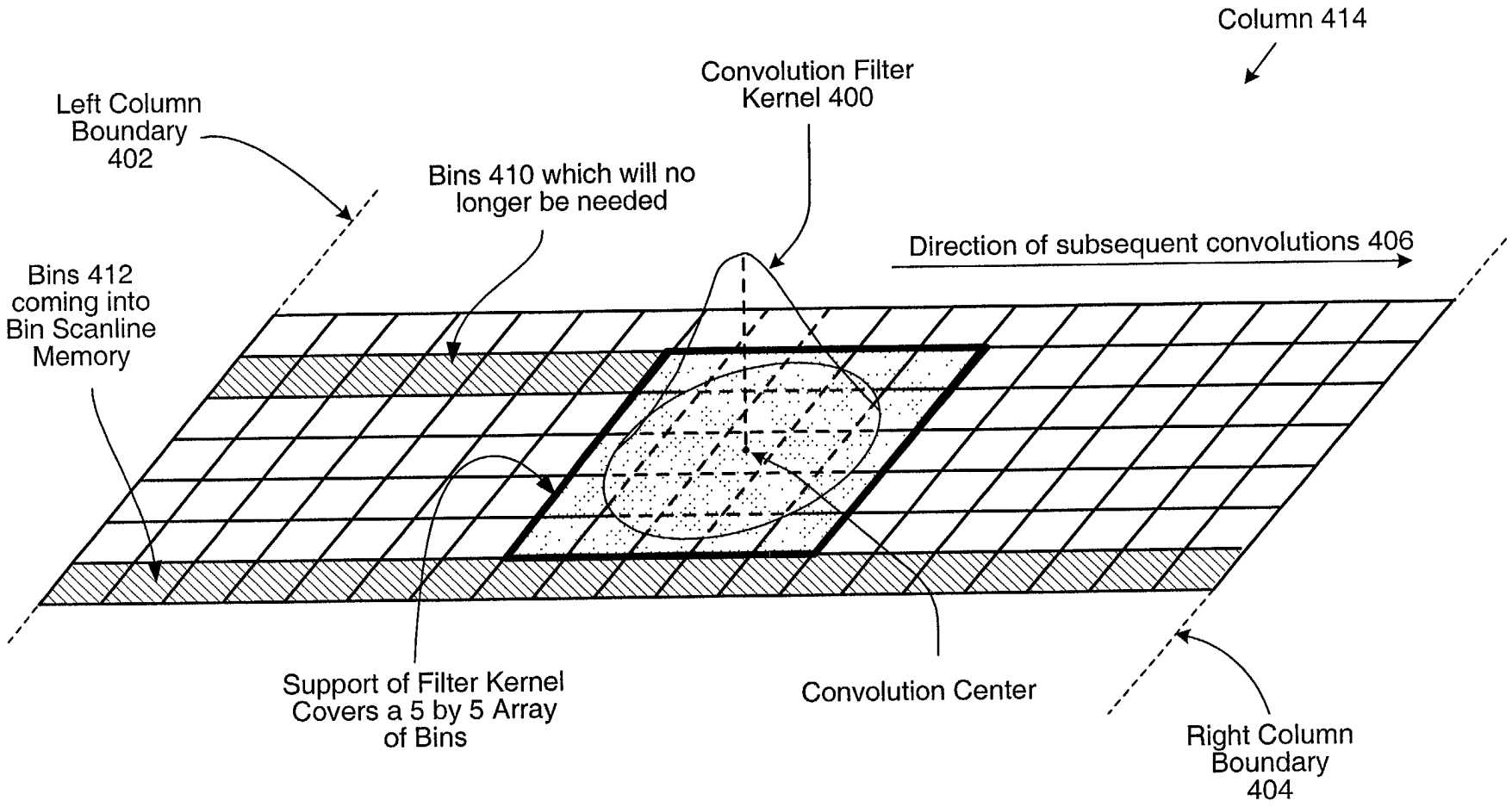


FIG. 11B

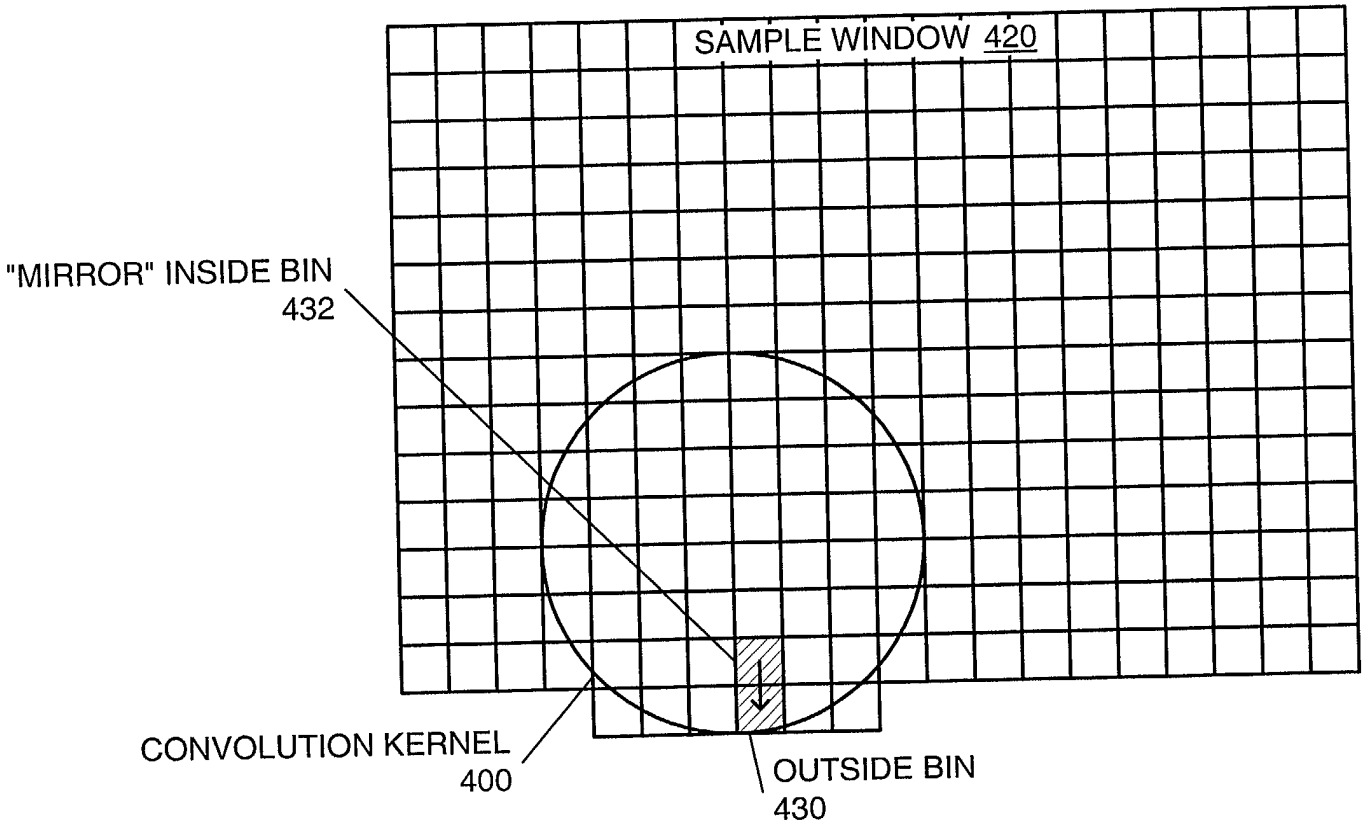


FIG. 11C

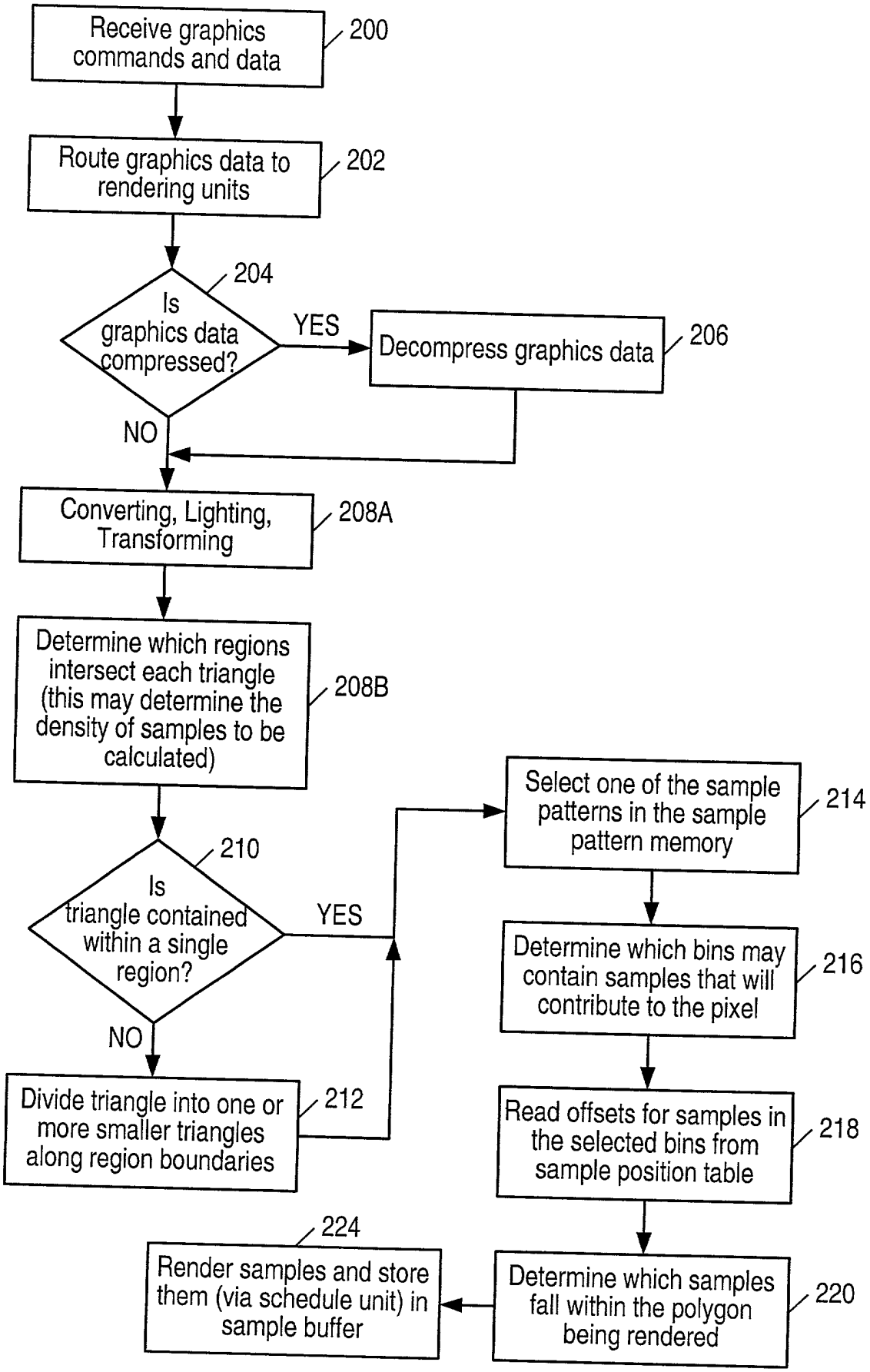

Receive graphics commands and data
200
Route graphics data to rendering units
202
204
Is graphics data compressed?
YES
Decompress graphics data
206
NO
Converting, Lighting, Transforming
208A
Determine which regions intersect each triangle (this may determine the density of samples to be calculated)
208B
210
Is triangle contained within a single region?
YES
NO
Divide triangle into one or more smaller triangles along region boundaries
212
Select one of the sample patterns in the sample pattern memory
214
Determine which bins may contain samples that will contribute to the pixel
216
Read offsets for samples in the selected bins from sample position table
218
Determine which samples fall within the polygon being rendered
220
224
Render samples and store them (via schedule unit) in sample buffer

FIG. 12A

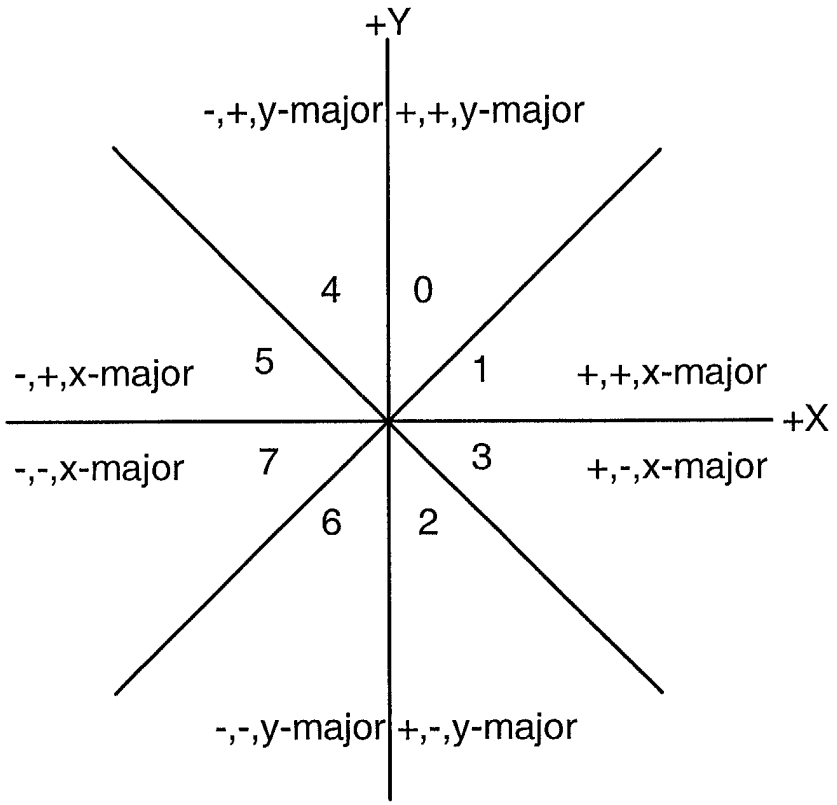


FIG. 12B

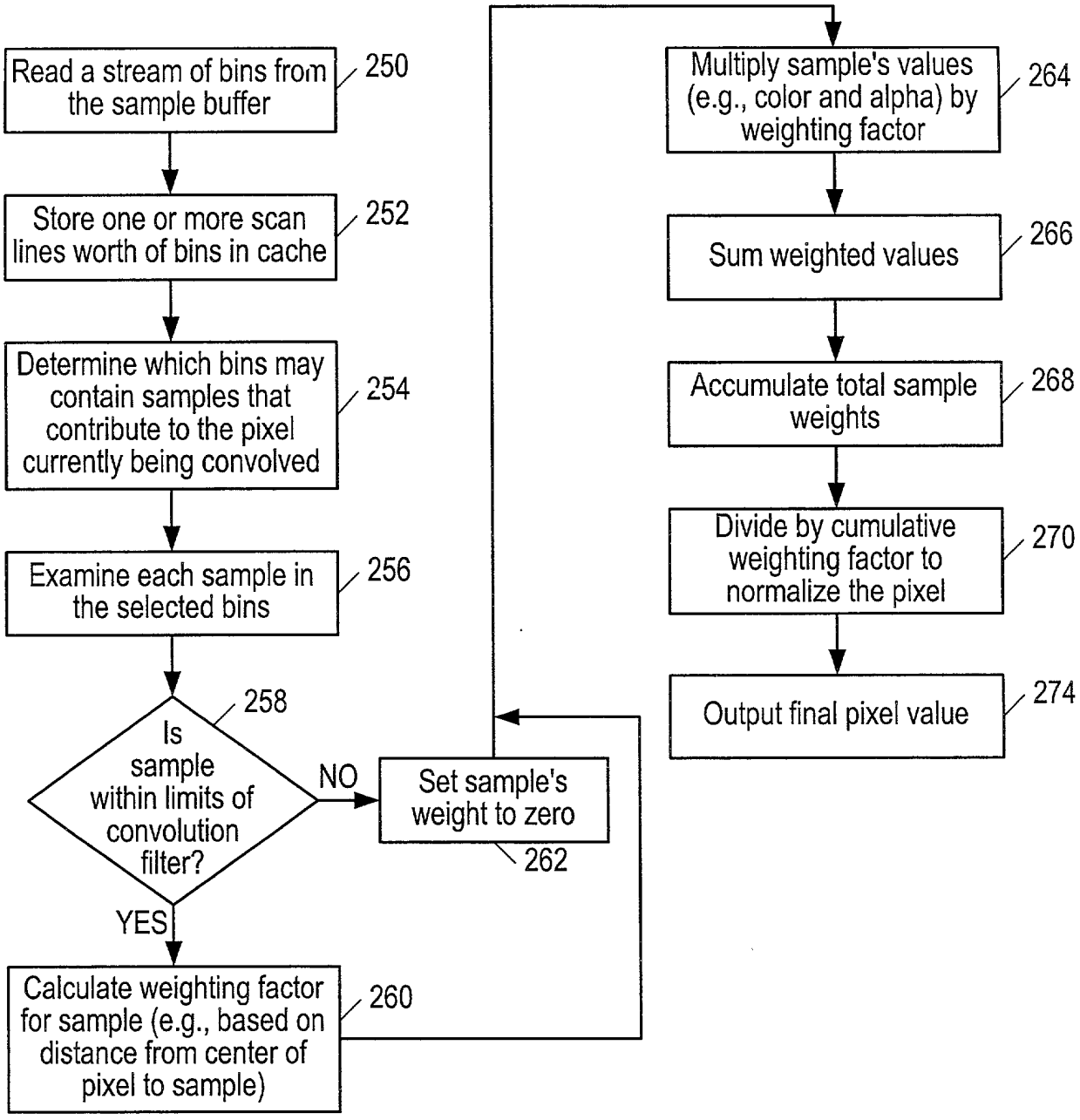
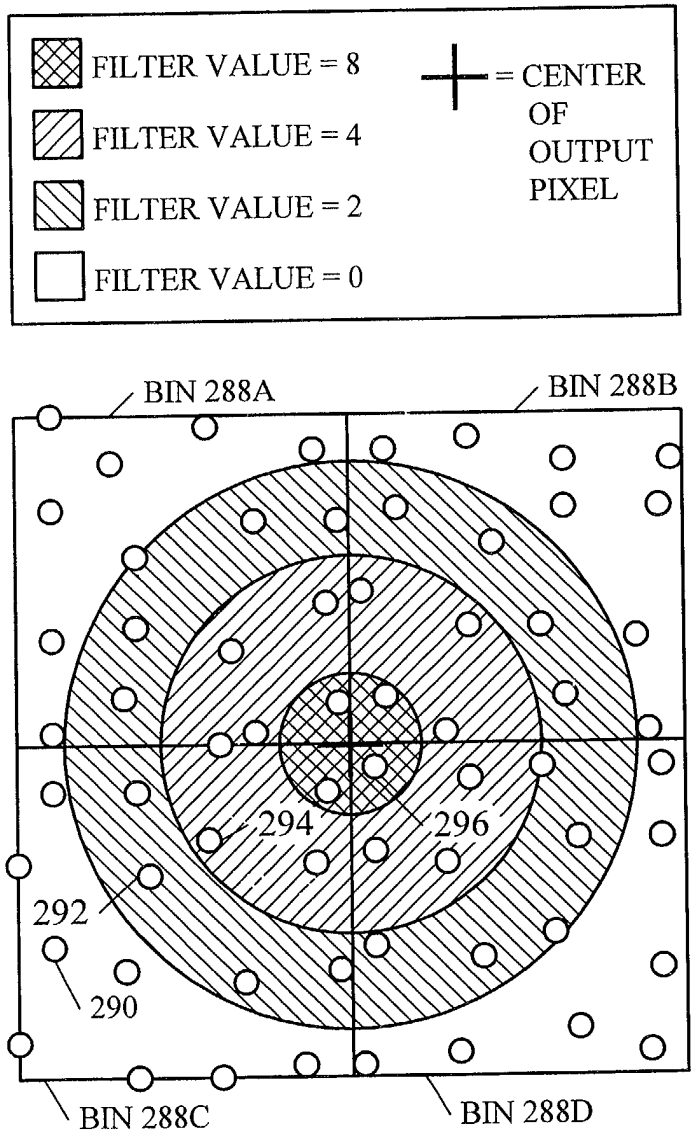

Read a stream of bins from the sample buffer
250
Store one or more scan lines worth of bins in cache
252
Determine which bins may contain samples that contribute to the pixel currently being convolved
254
Examine each sample in the selected bins
256
Is sample within limits of convolution filter?
258
NO
Set sample's weight to zero
262
YES
Calculate weighting factor for sample (e.g., based on distance from center of pixel to sample)
260
Multiply sample's values (e.g., color and alpha) by weighting factor
264
Sum weighted values
266
Accumulate total sample weights
268
Divide by cumulative weighting factor to normalize the pixel
270
Output final pixel value
274

FIG. 13



300

Sample 190

R = 120 FILTER
G = 200 VALUE = 0
B = 40
A = 150

302

Sample 192

R = 140 FILTER
G = 180 VALUE = 2
B = 50
A = 160

304

Sample 194

R = 150 FILTER
G = 170 VALUE = 4
B = 50
A = 180

306

Sample 196

R = 140 FILTER
G = 170 VALUE = 8
B = 60
A = 190

308

NORMALIZATION
VALUE = 0+2+4+8 = 14

310

UNNORMALIZED OUTPUT PIXEL

R = 120*0
+140*2
+150*4
+140*8 = 2000

G = 200*0
+180*2
+170*4
+170*8 = 2400

B = 40*0
+50*2
+50*4
+60*8 = 780

A = 150*0
+160*2
+180*4
+190*8 = 2560

312

NORMALIZED OUTPUT PIXEL

R = 2000 / 14 = 142.9
G = 2400 / 14 = 171.4
B = 780 / 14 = 55.7
A = 2560 / 14 = 175.7

FIG. 14

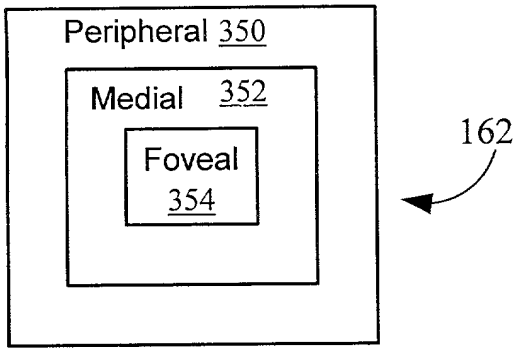


FIG. 15

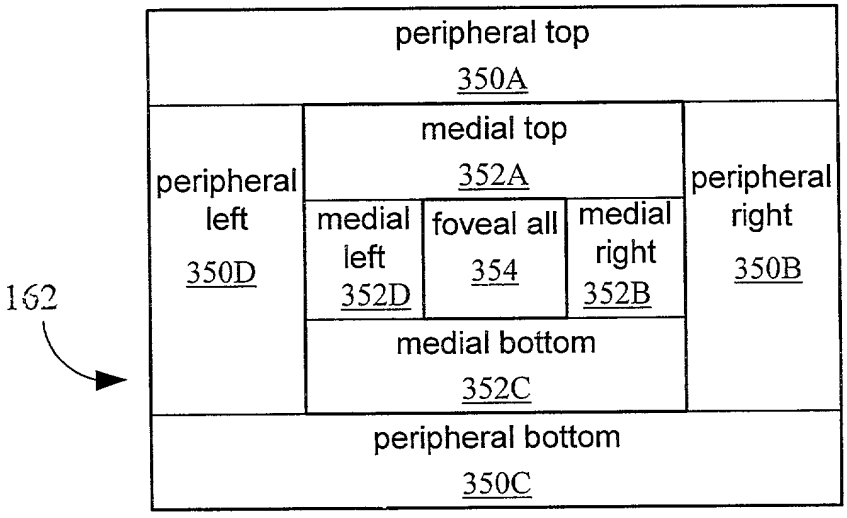


FIG. 16

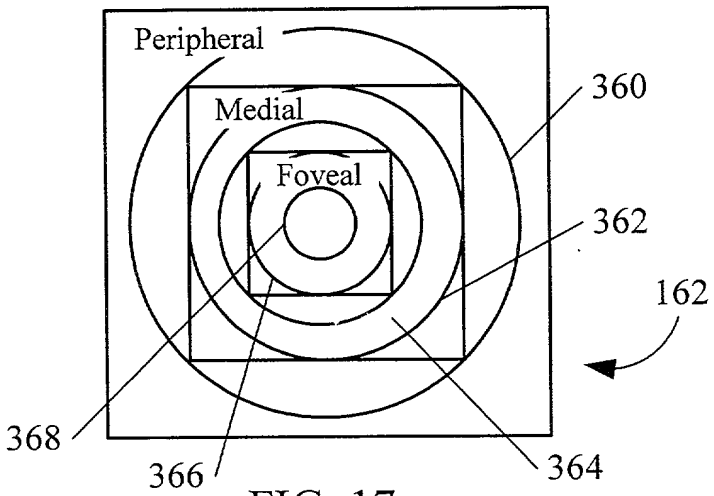
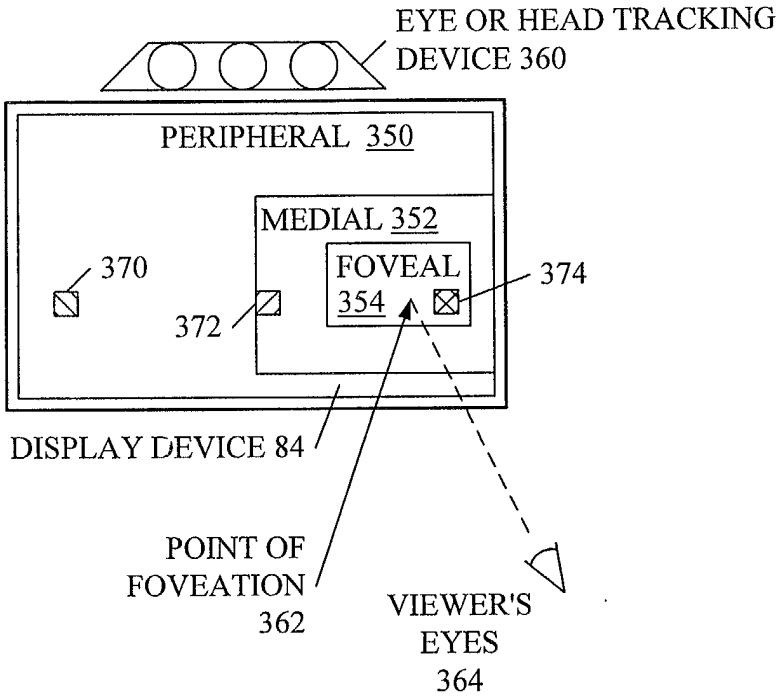
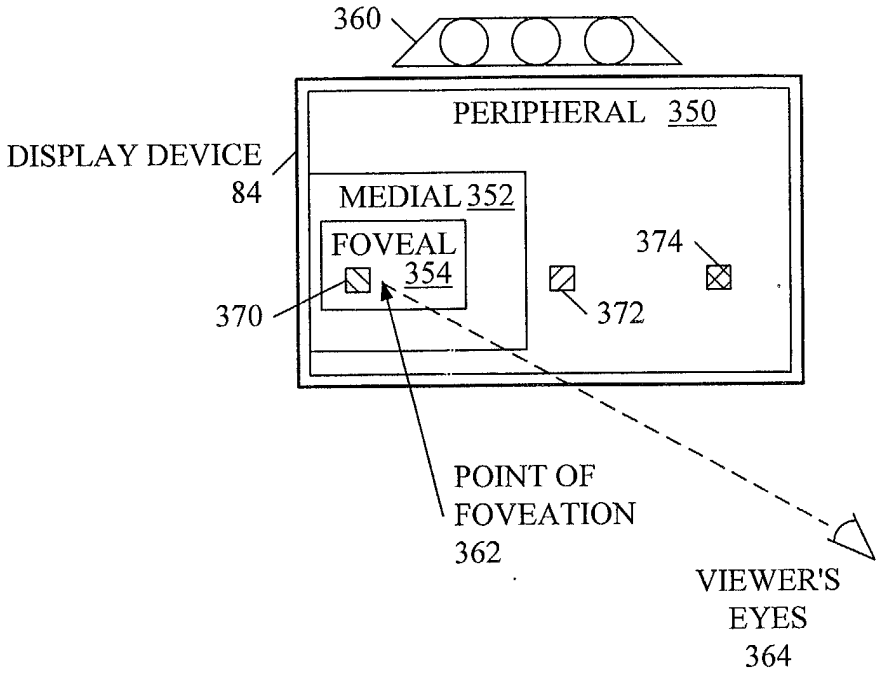


FIG. 17



- FOVEAL REGION = 8 SAMPLES PER BIN
  CONVOLUTION RADIUS TOUCHES 4 BINS
  TOTAL = 32 SAMPLES MAY CONTRIBUTE
- MEDIAL REGION = 4 SAMPLES PER BIN
  CONVOLUTION RADIUS TOUCHES 4 BINS
  TOTAL = 16 SAMPLES MAY CONTRIBUTE
- PERIPHERAL REGION = 1 SAMPLE PER BIN
  CONVOLUTION RADIUS TOUCHES 1 BIN
  TOTAL = 1 SAMPLE MAY CONTRIBUTE

FIG. 18A



- PERIPHERAL REGION = 1 SAMPLE PER BIN
  CONVOLUTION RADIUS TOUCHES 1 BIN
  TOTAL = 1 SAMPLE MAY CONTRIBUTE
- PERIPHERAL REGION = 1 SAMPLE PER BIN
  CONVOLUTION RADIUS TOUCHES 1 BINS
  TOTAL = 1 SAMPLE MAY CONTRIBUTE
- FOVEAL REGION = 8 SAMPLES PER BIN
  CONVOLUTION RADIUS TOUCHES 4 BIN
  TOTAL = 32 SAMPLE MAY CONTRIBUTE

FIG. 18B

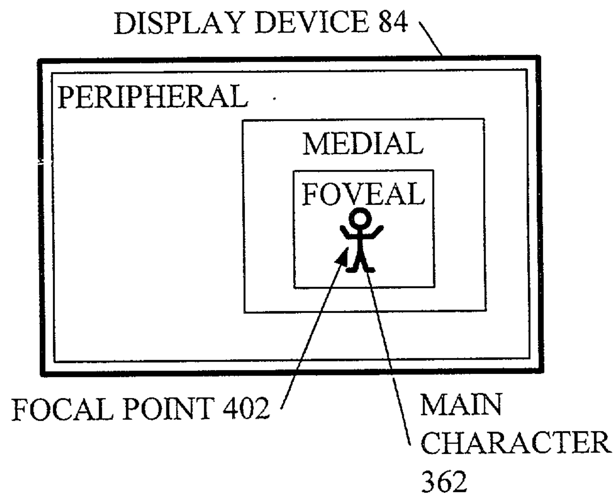


FIG. 19A

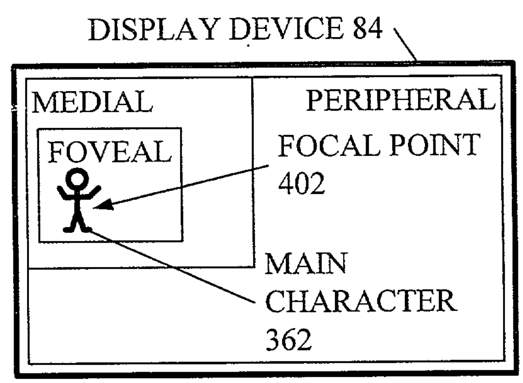


FIG. 19B

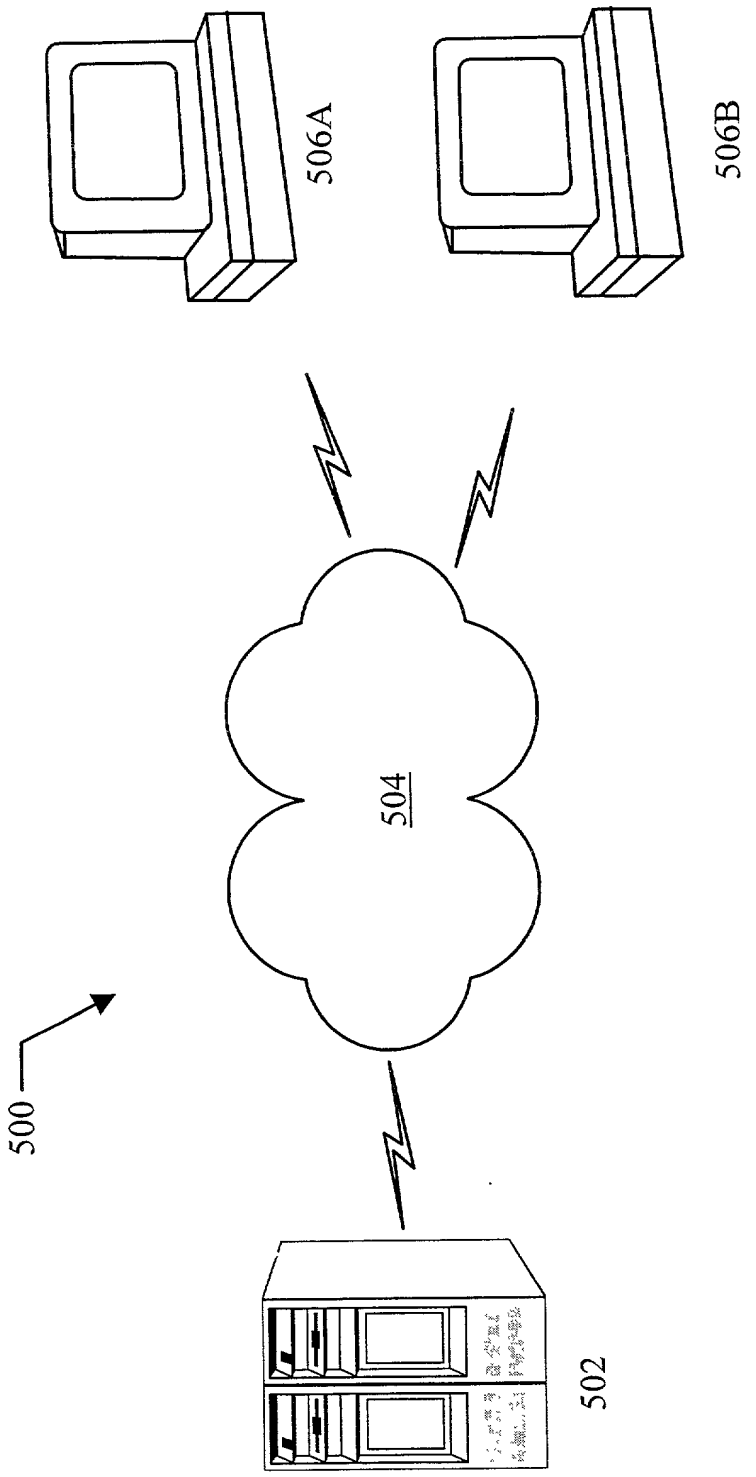


FIG. 20

$$r_i^p = \sum_J c_J r_J^s \qquad \text{Eqn. 1}$$

$$g_i^p = \sum_J c_J g_J^s \qquad \text{Eqn. 2}$$

$$b_i^p = \sum_J c_J b_J^s \qquad \text{Eqn. 3}$$

$$\alpha_i^p = \sum_j c_J \alpha_J^s \qquad \text{Eqn. 4}$$

$$c_i^n = \frac{c_i}{\sum_J c_j} \qquad \text{Eqn. 5}$$

$$r_i^p = \frac{\sum_J c_j r_J^s}{\sum_J c_j} \qquad \text{Eqn. 6}$$

$$g_i^p = \frac{\sum_J c_J g_J^s}{\sum_J c_j} \qquad \text{Eqn. 7}$$

$$b_i^p = \frac{\sum_J c_j b_J^s}{\sum_J c_J} \qquad \text{Eqn. 8}$$

$$\alpha_i^p = \frac{\sum_J c_J \alpha_J^s}{\sum_J c_j} \qquad \text{Eqn. 9}$$

Figure 21

FIG. 22A

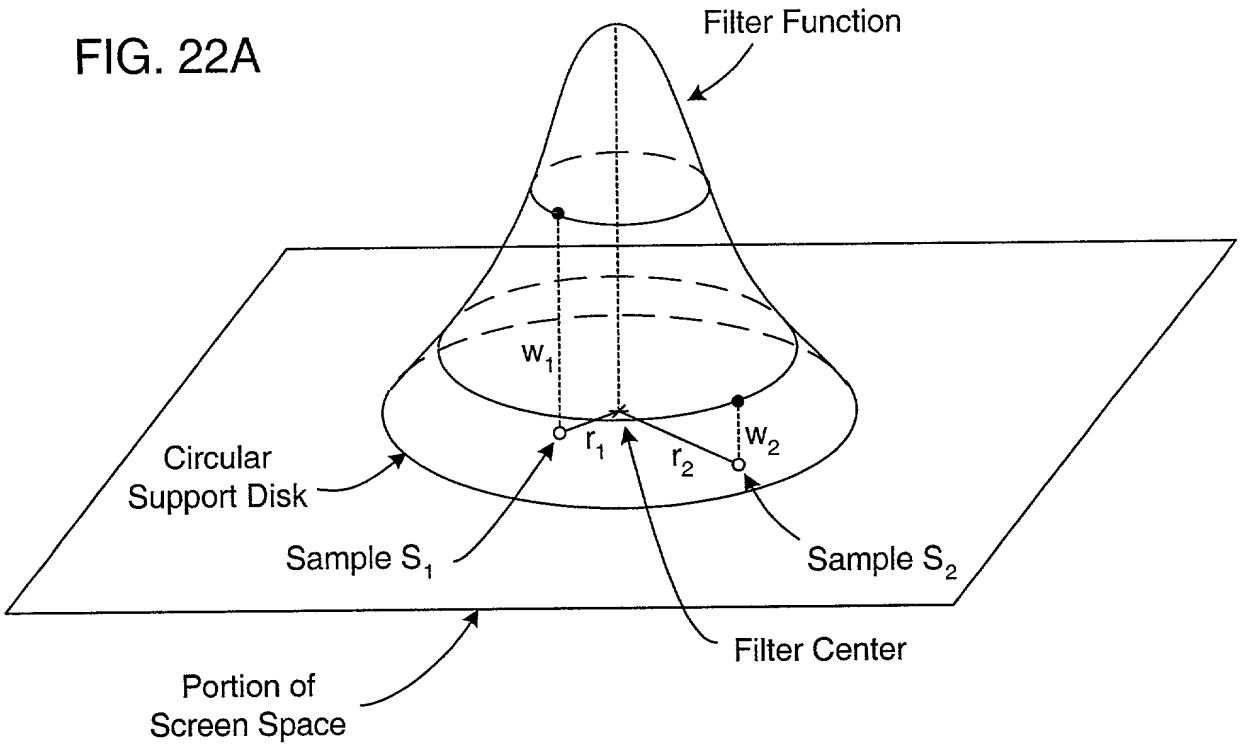


FIG. 22B

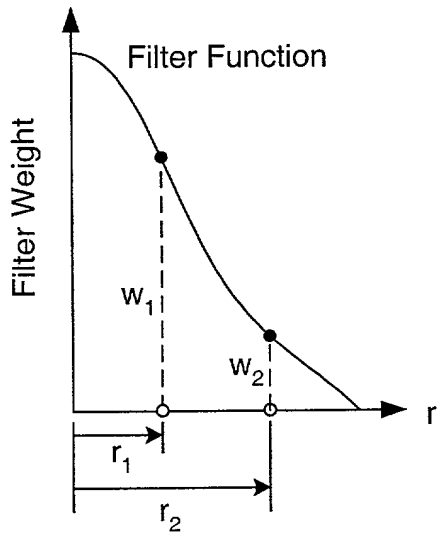


Fig. 23A

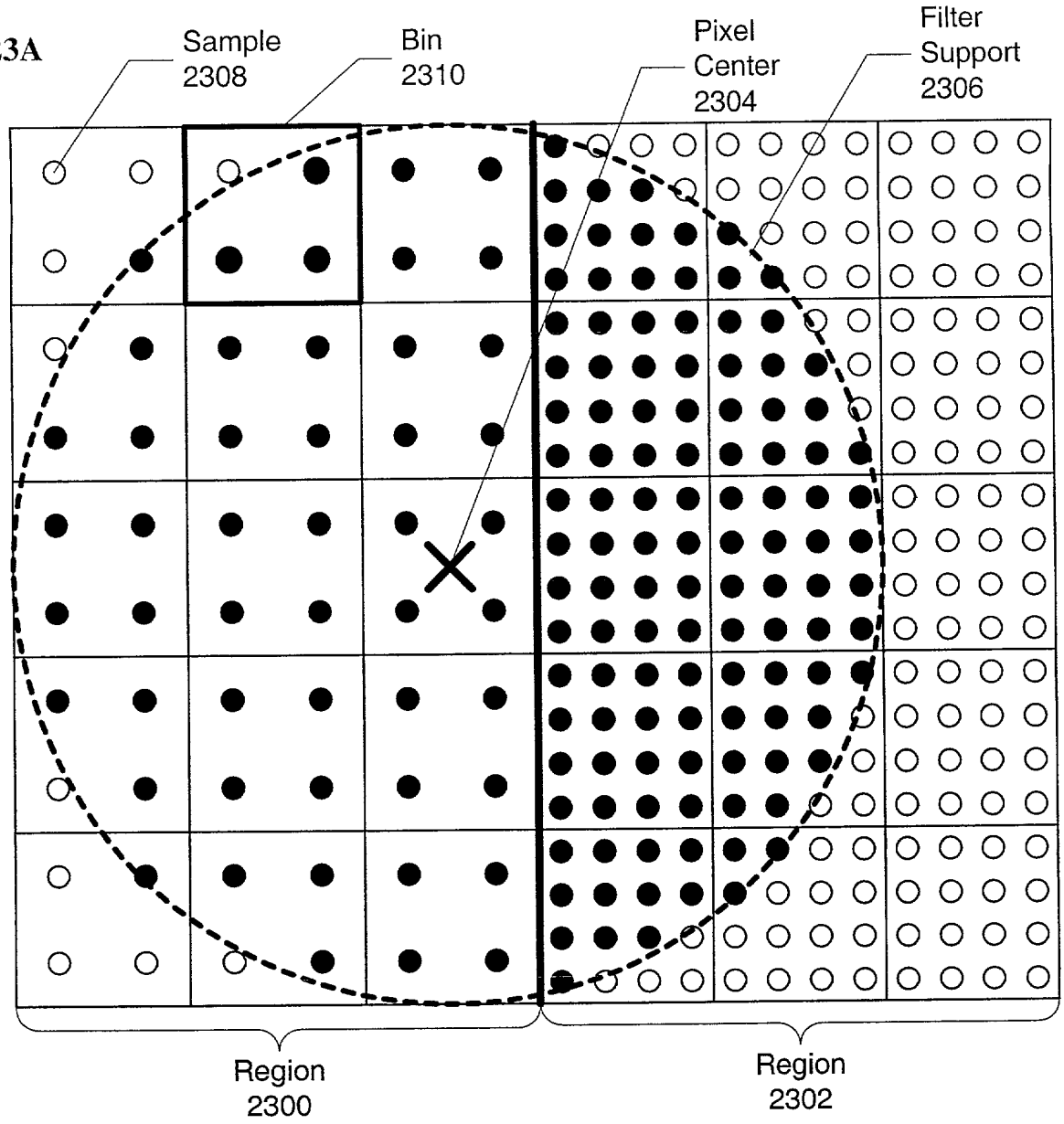


Fig. 23B

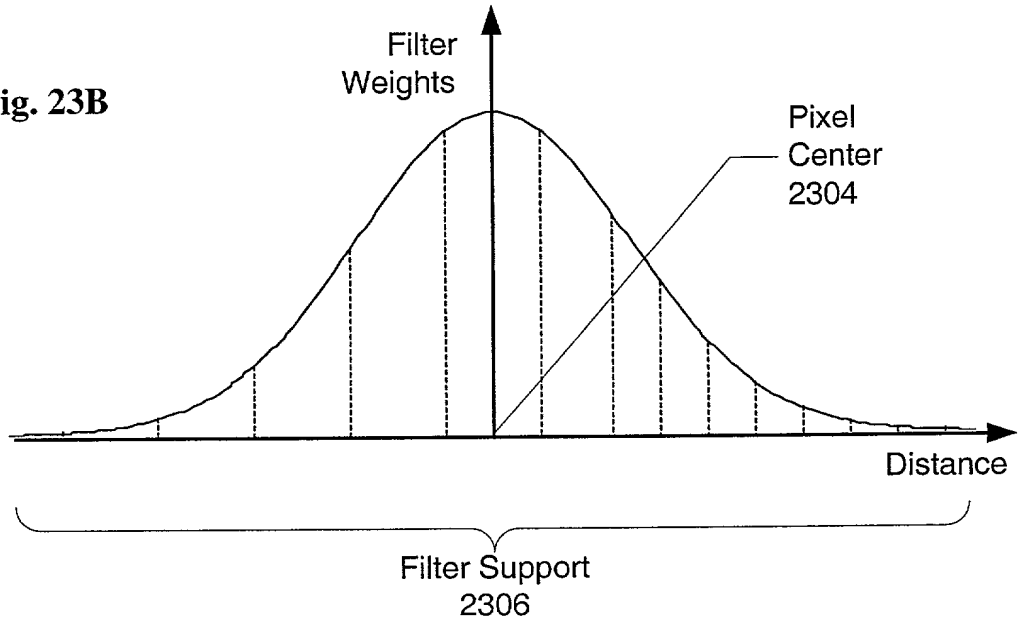


Fig. 24A

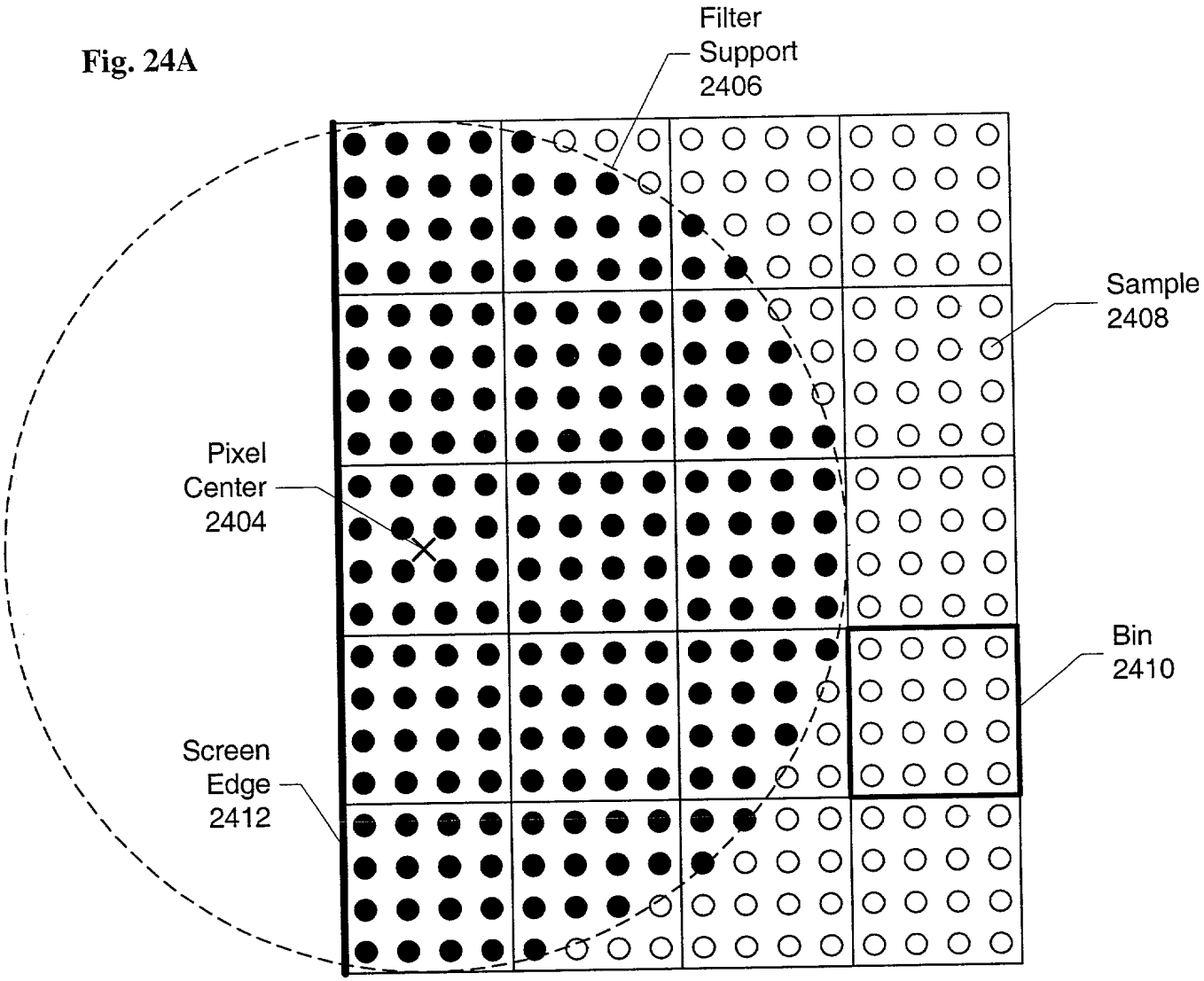


Fig. 24B

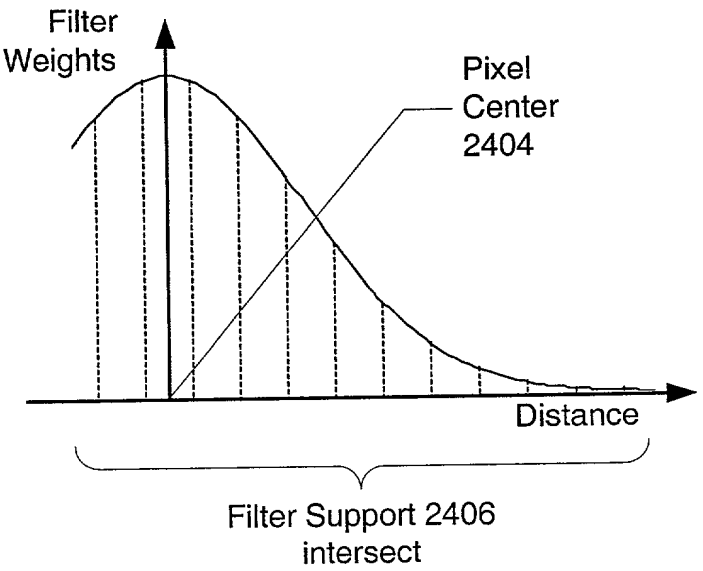


Fig. 25A

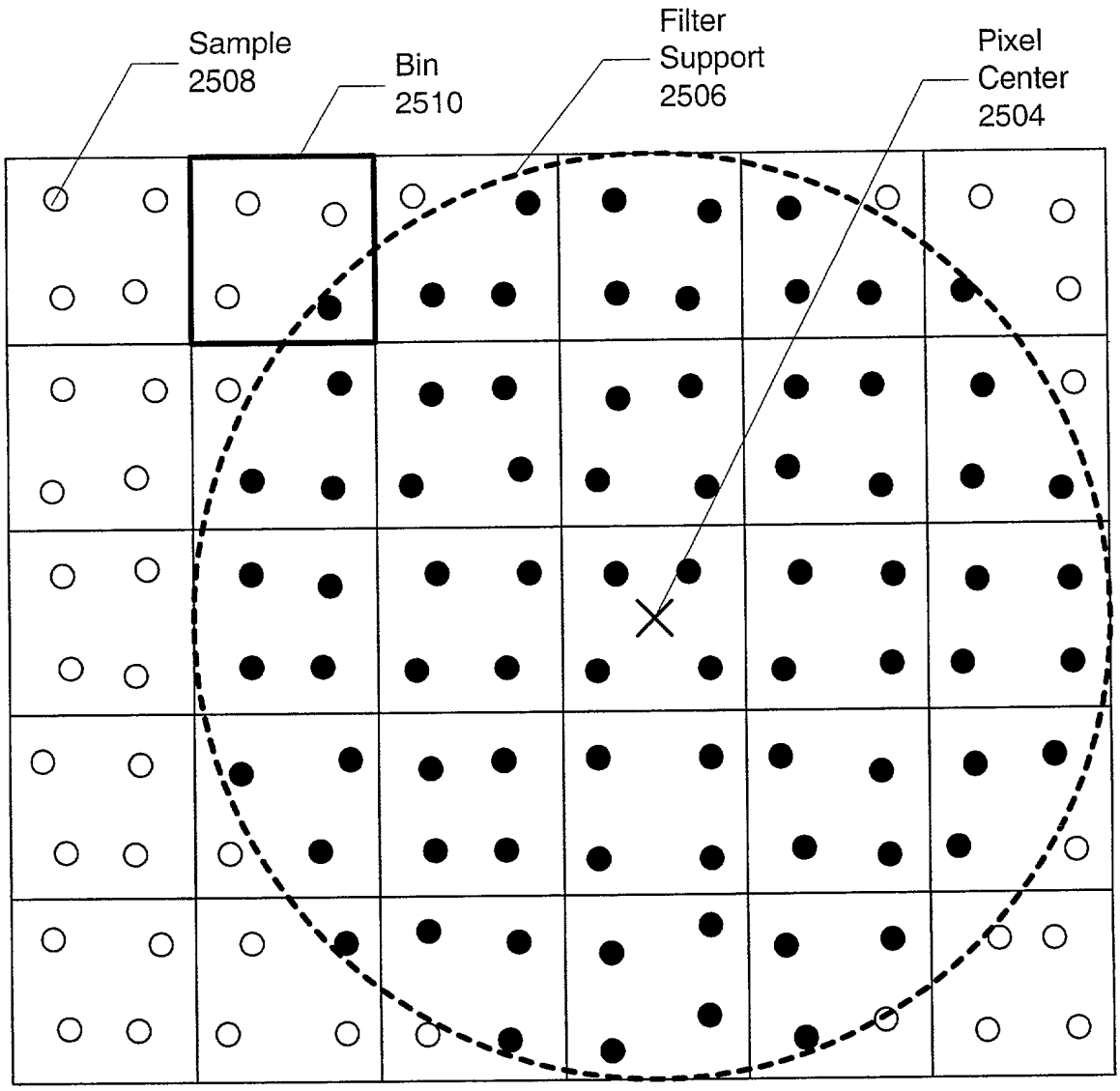
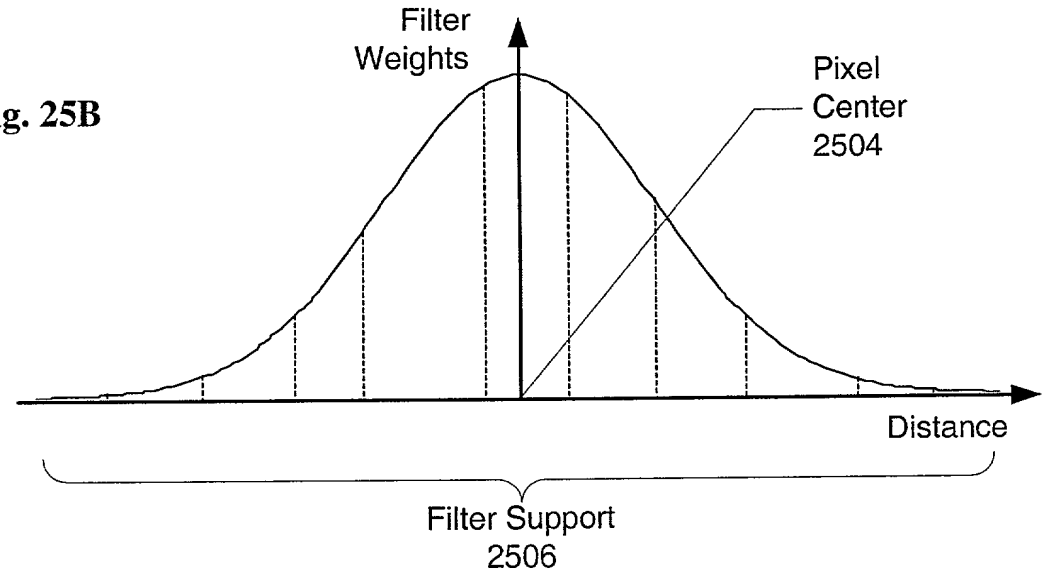


Fig. 25B



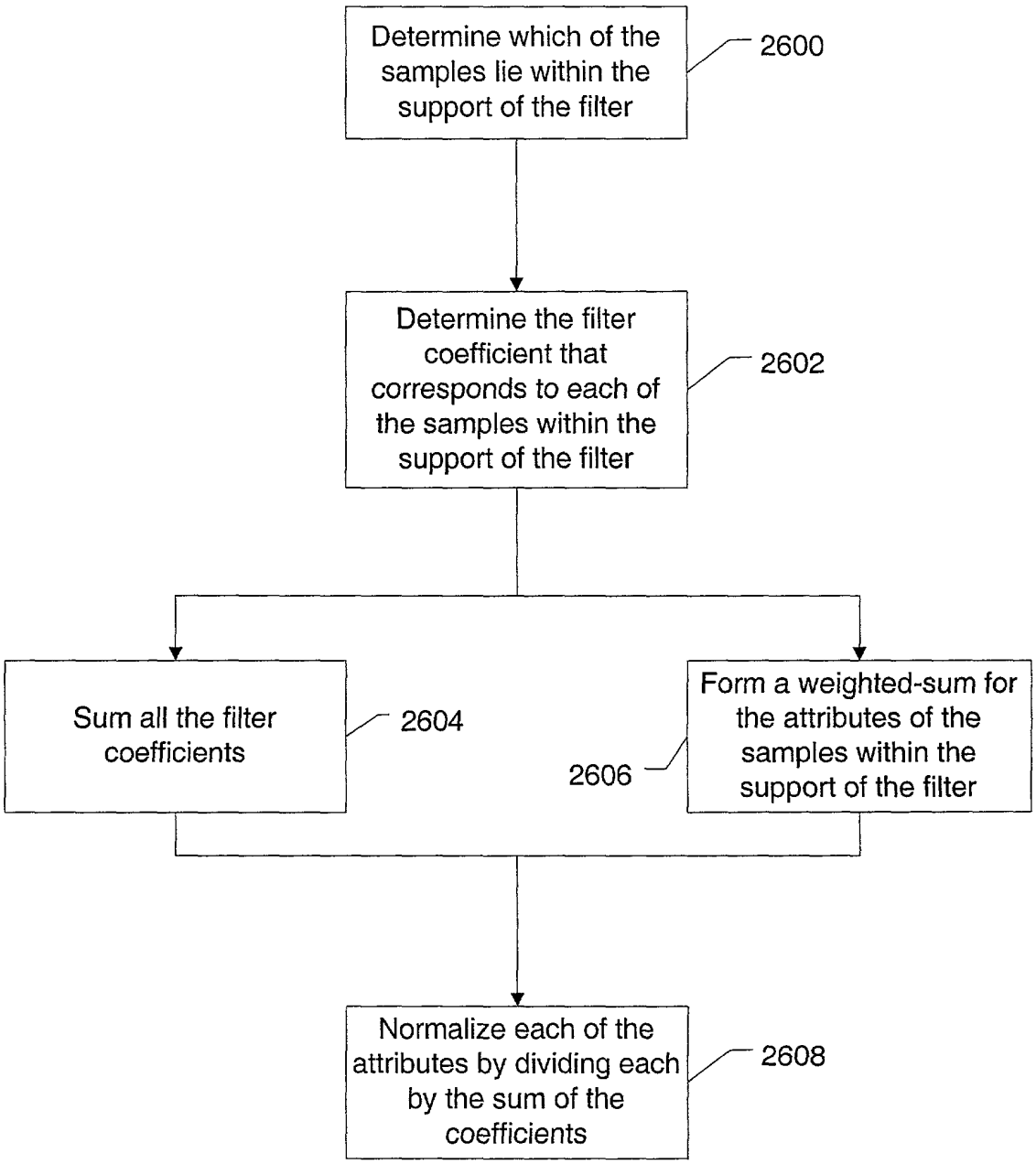

Determine which of the samples lie within the support of the filter
2600
Determine the filter coefficient that corresponds to each of the samples within the support of the filter
2602
Sum all the filter coefficients
2604
2606
Form a weighted-sum for the attributes of the samples within the support of the filter
Normalize each of the attributes by dividing each by the sum of the coefficients
2608

Figure 26

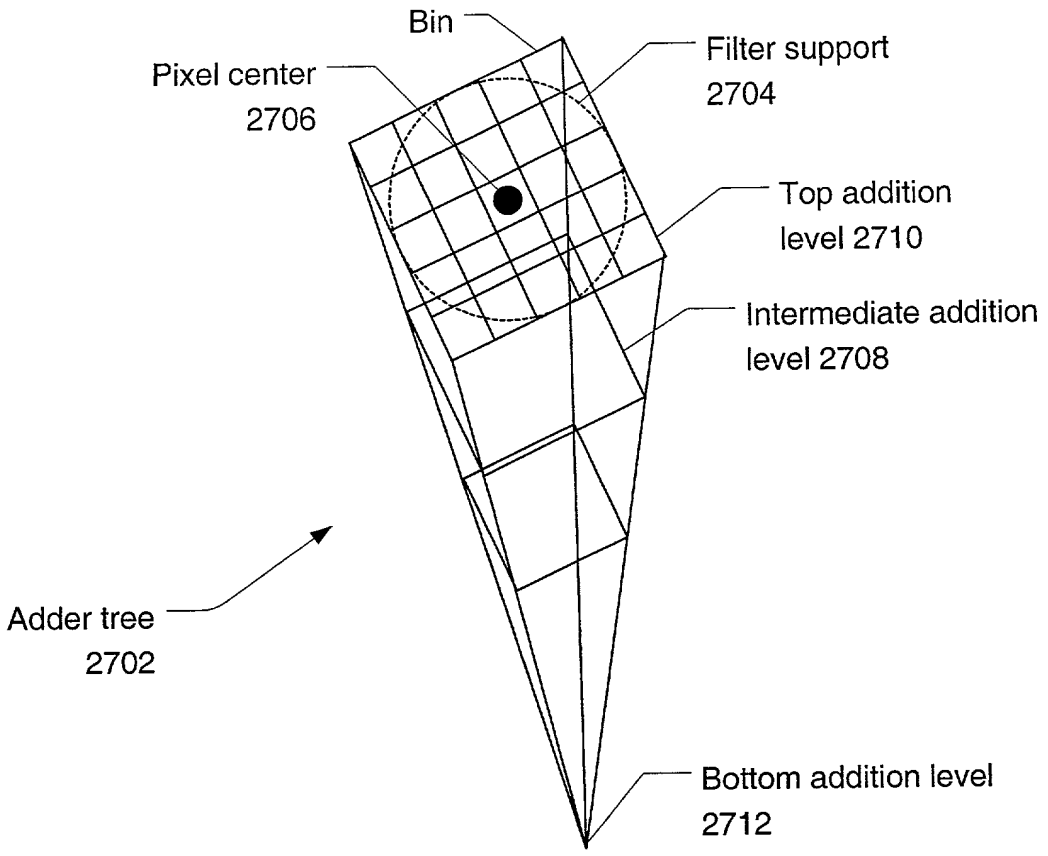

Bin
Pixel center
2706
Filter support
2704
Top addition
level 2710
Intermediate addition
level 2708
Adder tree
2702
Bottom addition level
2712

Figure 27

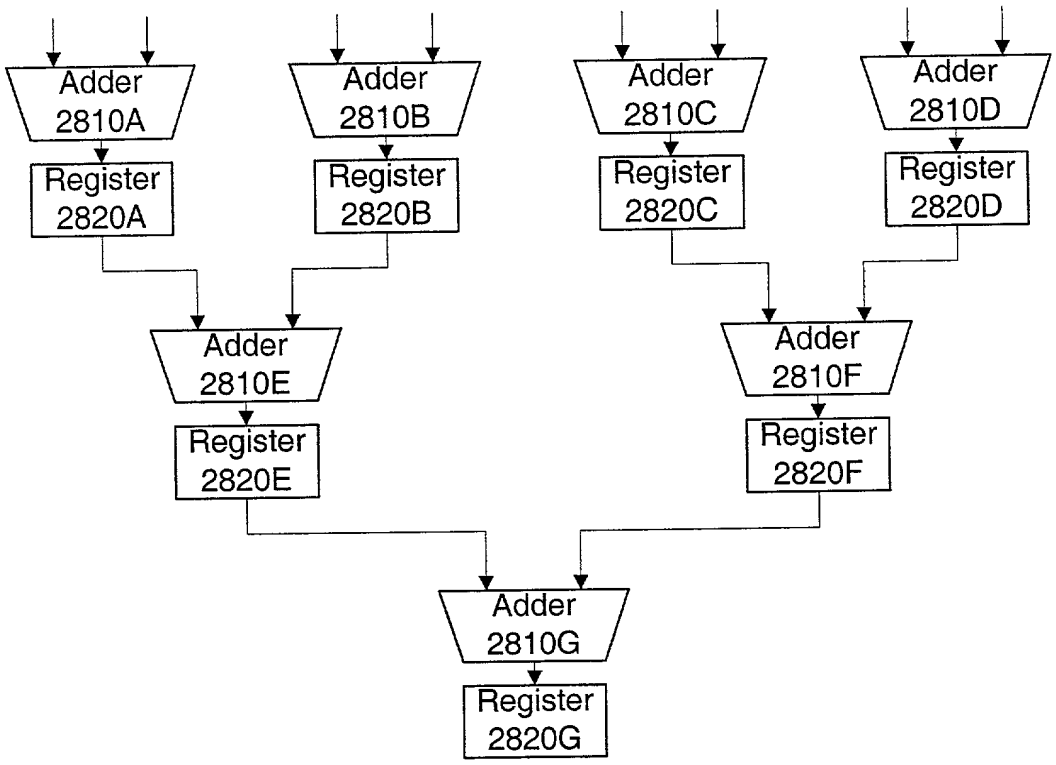

Adder 2810A
Adder 2810B
Adder 2810C
Adder 2810D
Register 2820A
Register 2820B
Register 2820C
Register 2820D
Adder 2810E
Adder 2810F
Register 2820E
Register 2820F
Adder 2810G
Register 2820G

Figure 28

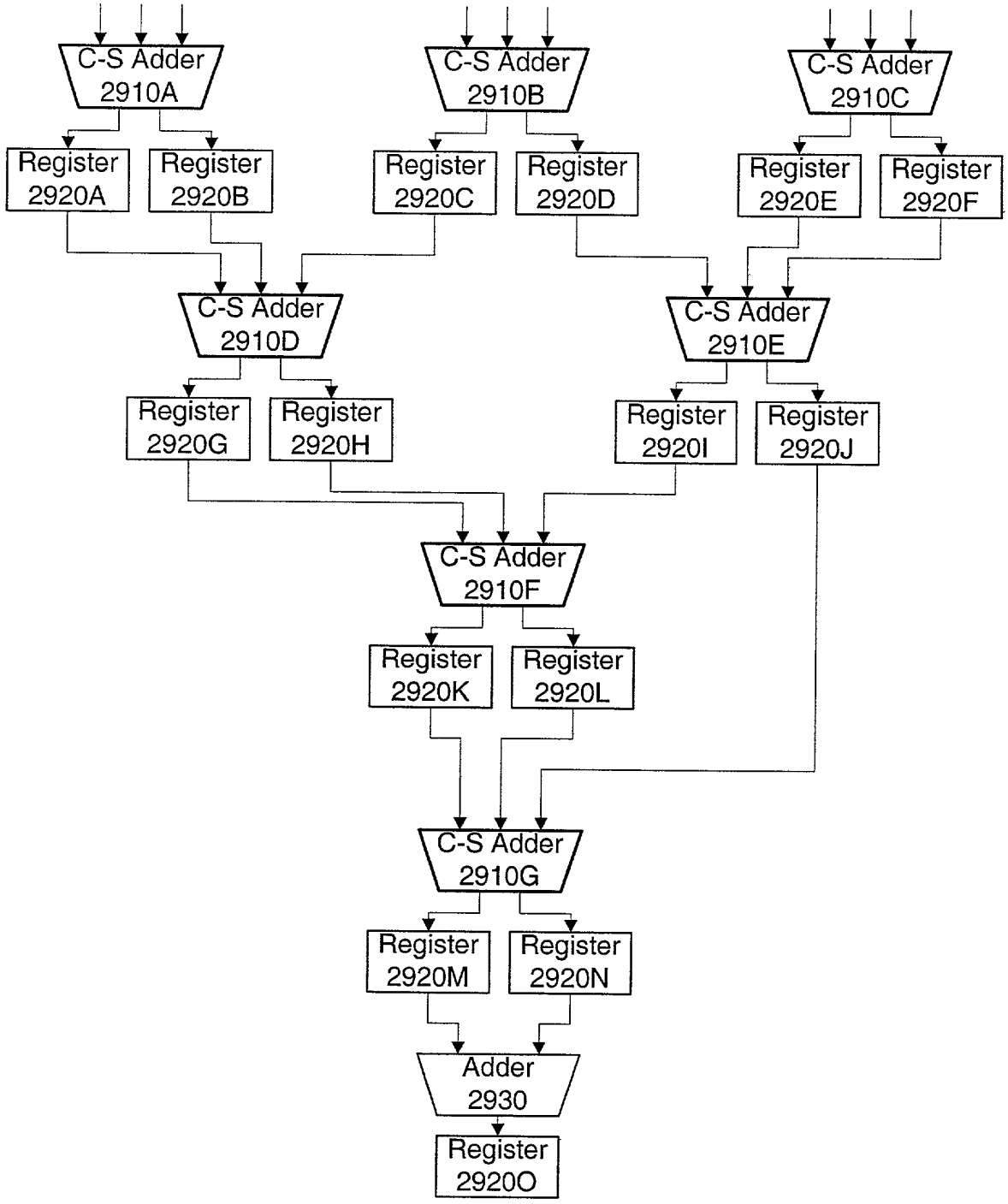

C-S Adder 2910A
C-S Adder 2910B
C-S Adder 2910C
Register 2920A
Register 2920B
Register 2920C
Register 2920D
Register 2920E
Register 2920F
C-S Adder 2910D
C-S Adder 2910E
Register 2920G
Register 2920H
Register 2920I
Register 2920J
C-S Adder 2910F
Register 2920K
Register 2920L
C-S Adder 2910G
Register 2920M
Register 2920N
Adder 2930
Register 2920O

Figure 29

Fig. 30A

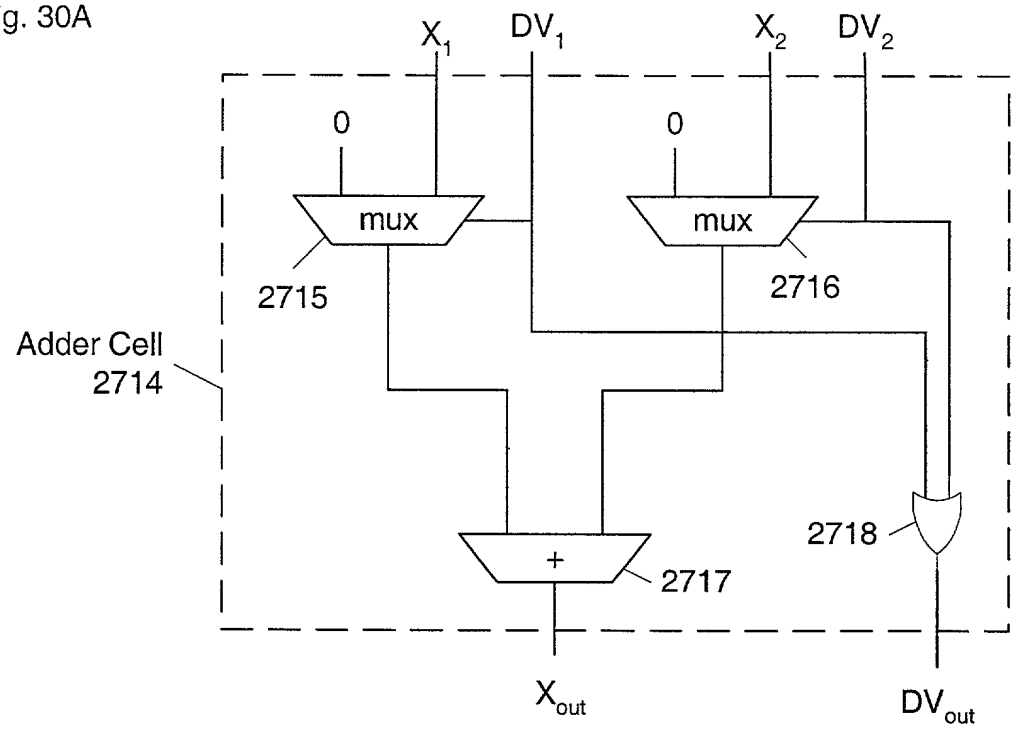


Fig. 30B

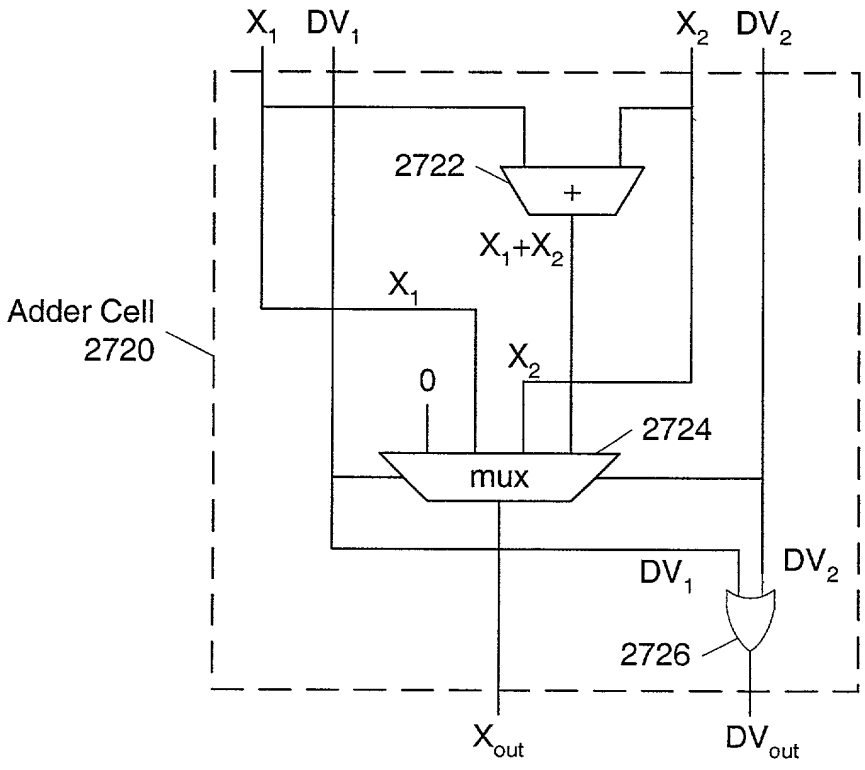


Fig. 31

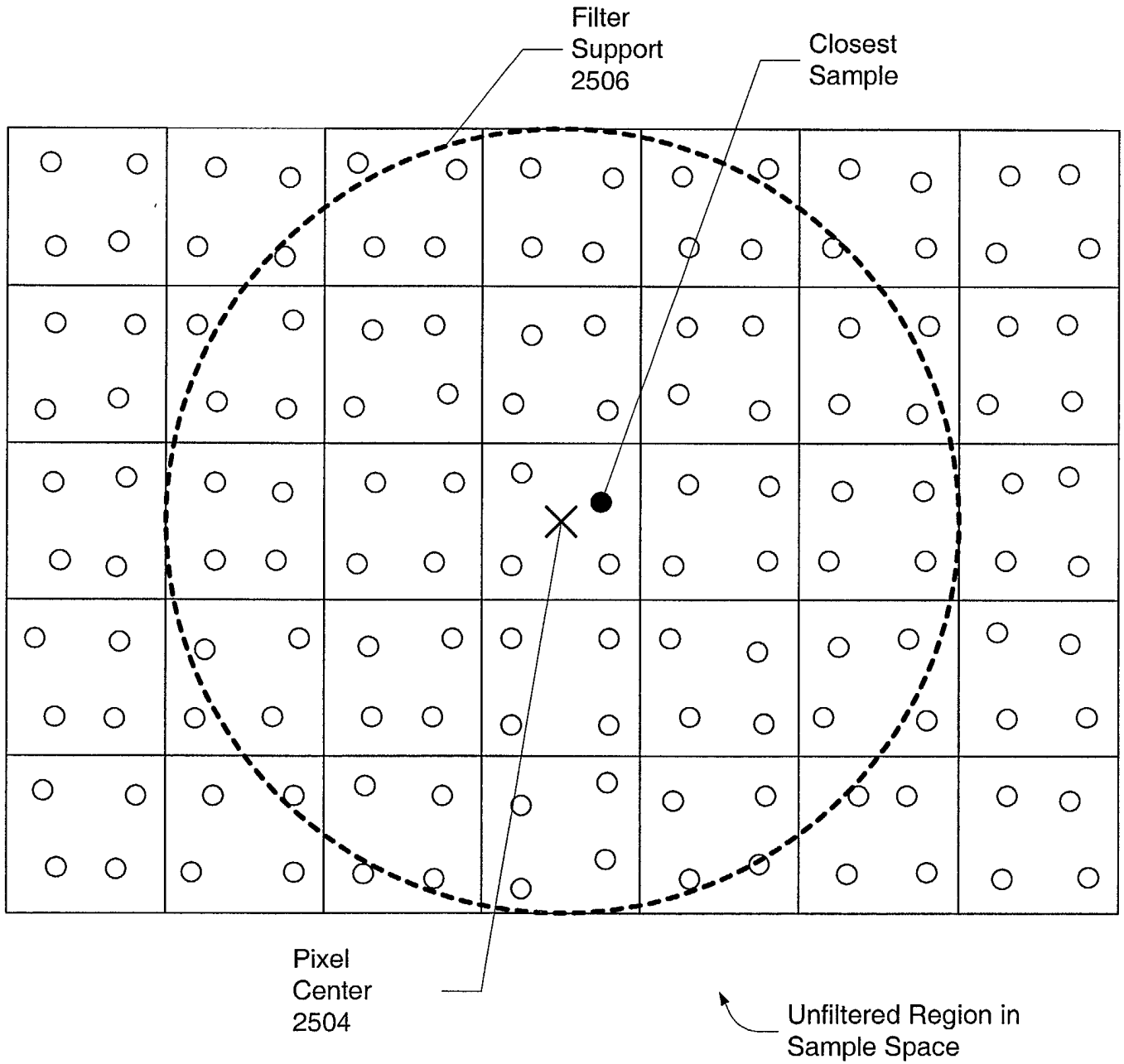
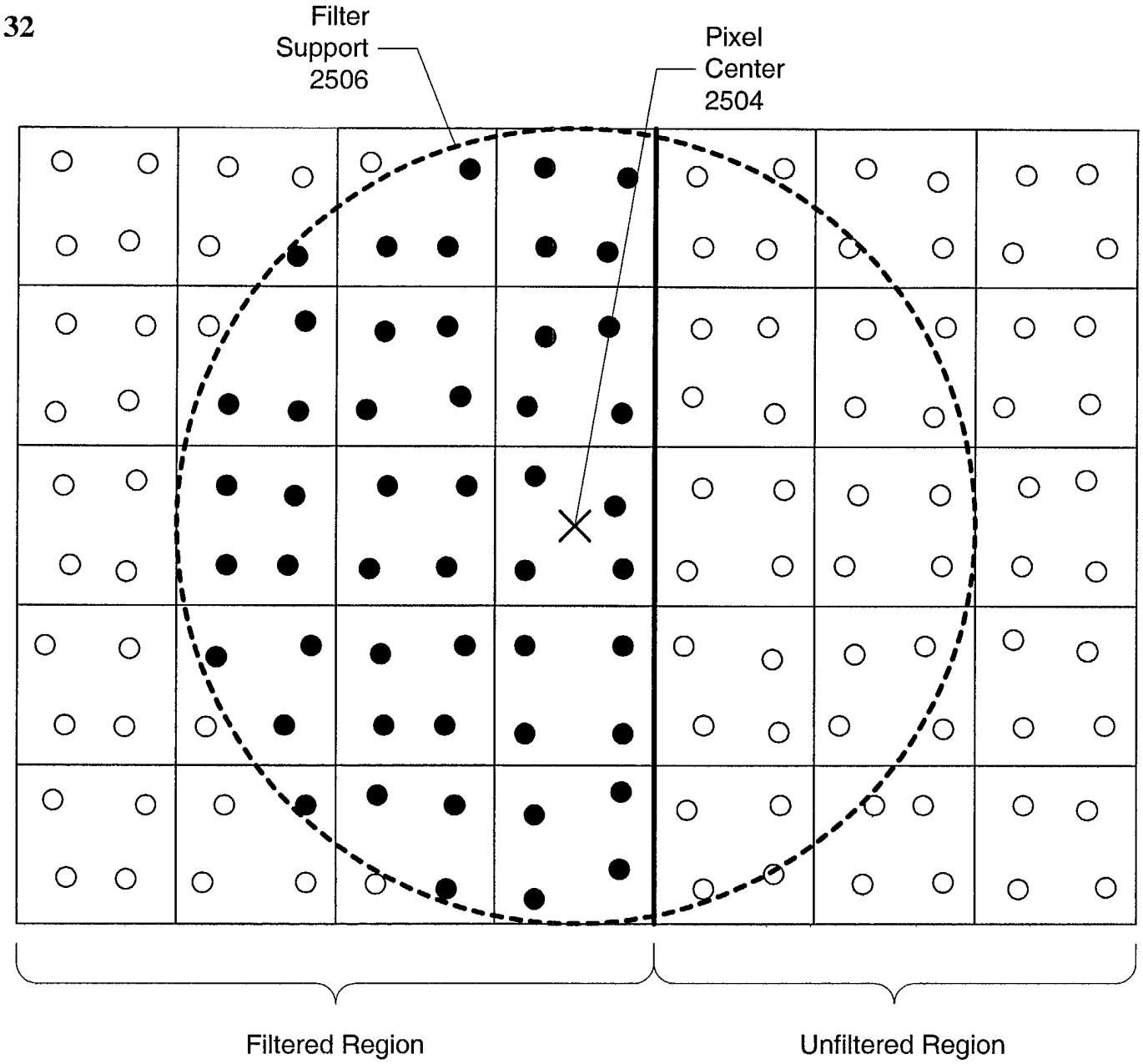


Fig. 32



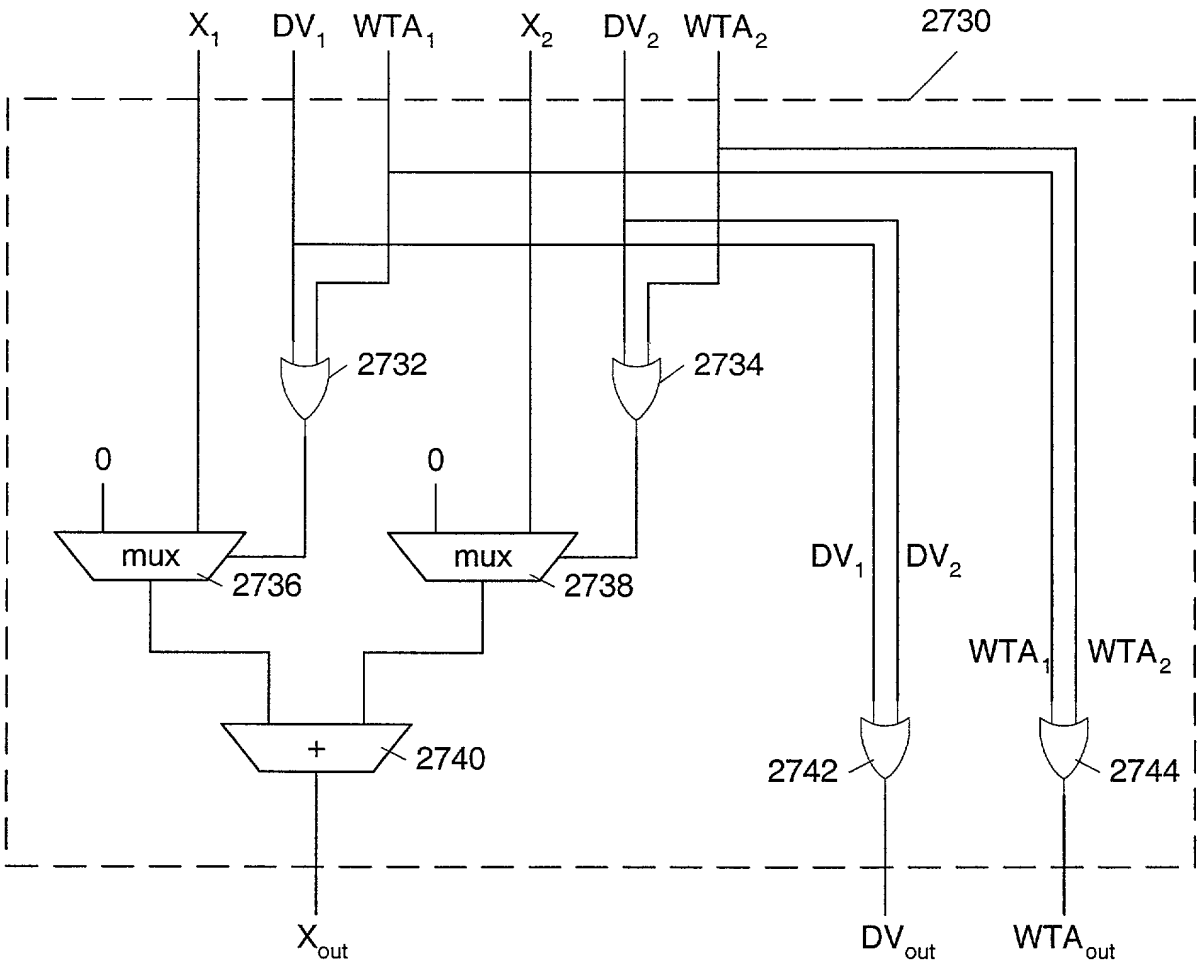

X1
DV1
WTA1
X2
DV2
WTA2
2730
2732
2734
0
0
mux
2736
mux
2738
DV1
DV2
WTA1
WTA2
+
2740
2742
2744
Xout
DVout
WTAout

Fig. 33A

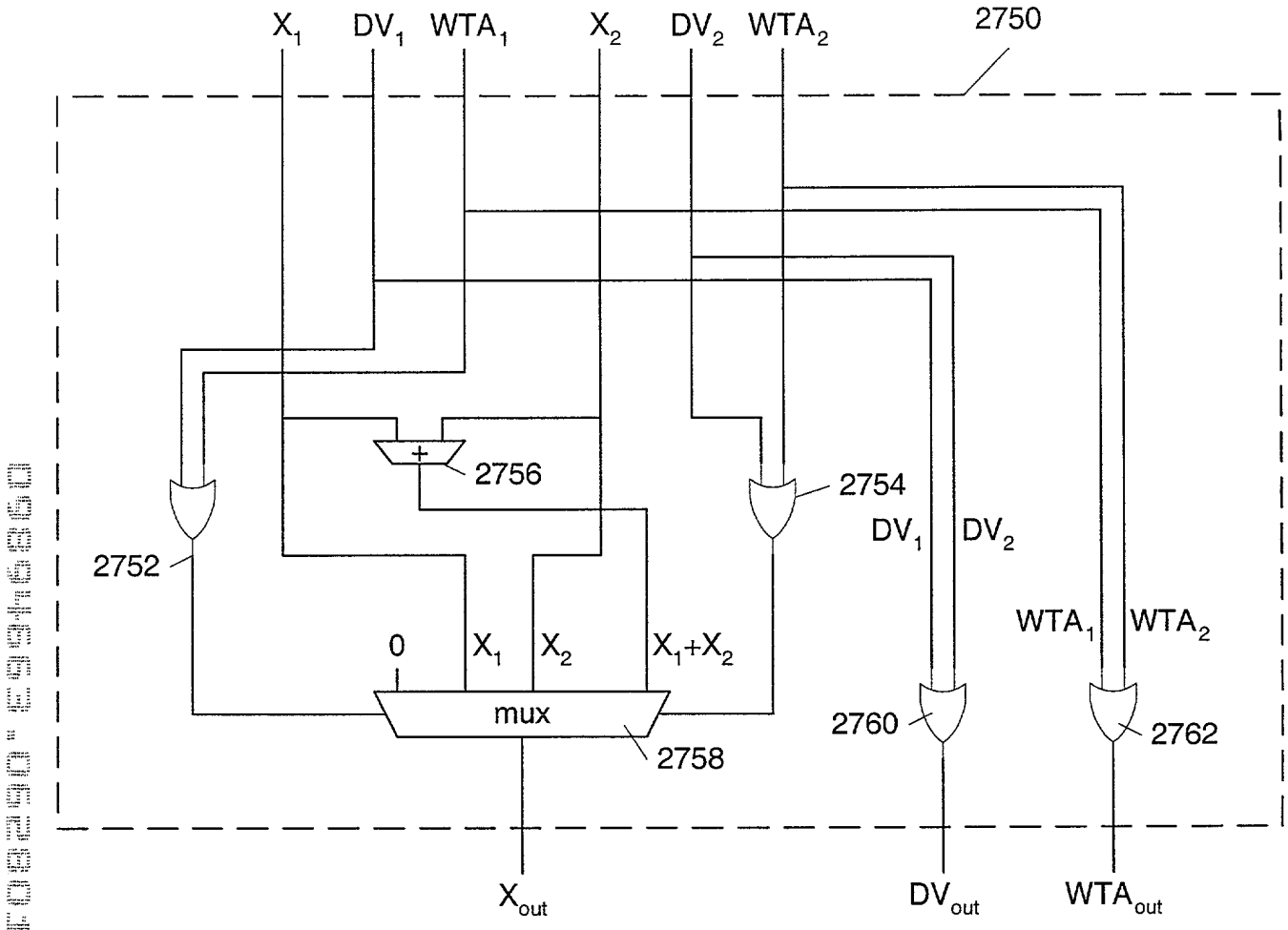

X1
DV1
WTA1
X2
DV2
WTA2
2750
+
2756
2752
2754
DV1
DV2
WTA1
WTA2
0
X1
X2
X1+X2
mux
2758
2760
2762
Xout
DVout
WTAout

Fig. 33B

Figure 33C

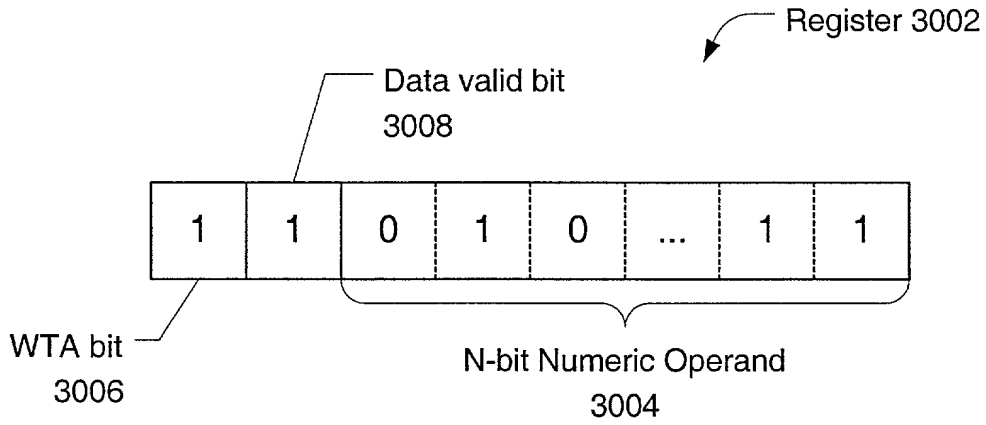
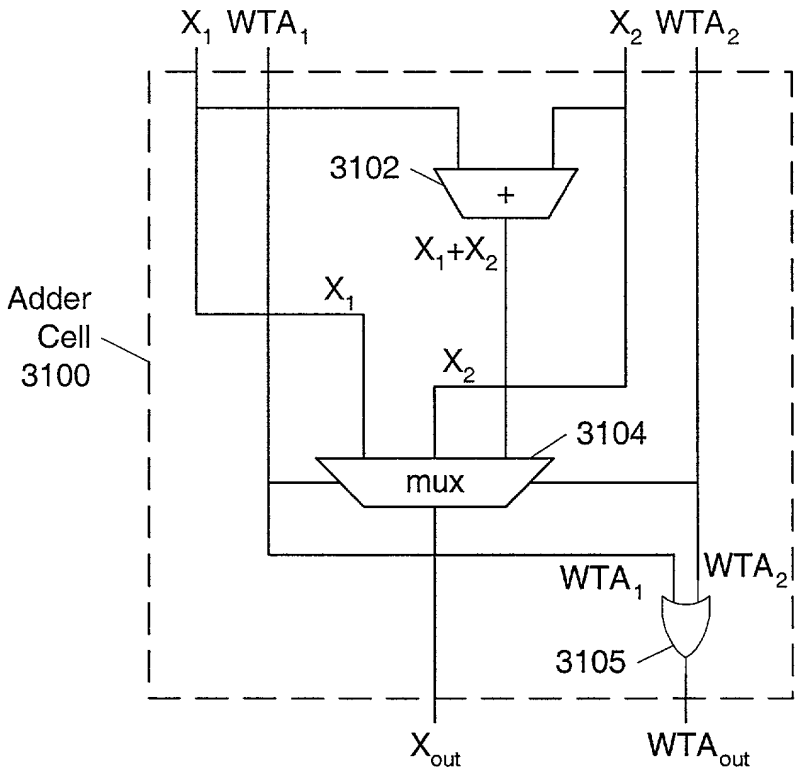


Fig. 34


X1 WTA1
X2 WTA2
3102
+
X1+X2
X1
Adder
Cell
3100
X2
3104
mux
WTA1
WTA2
3105
Xout
WTAout

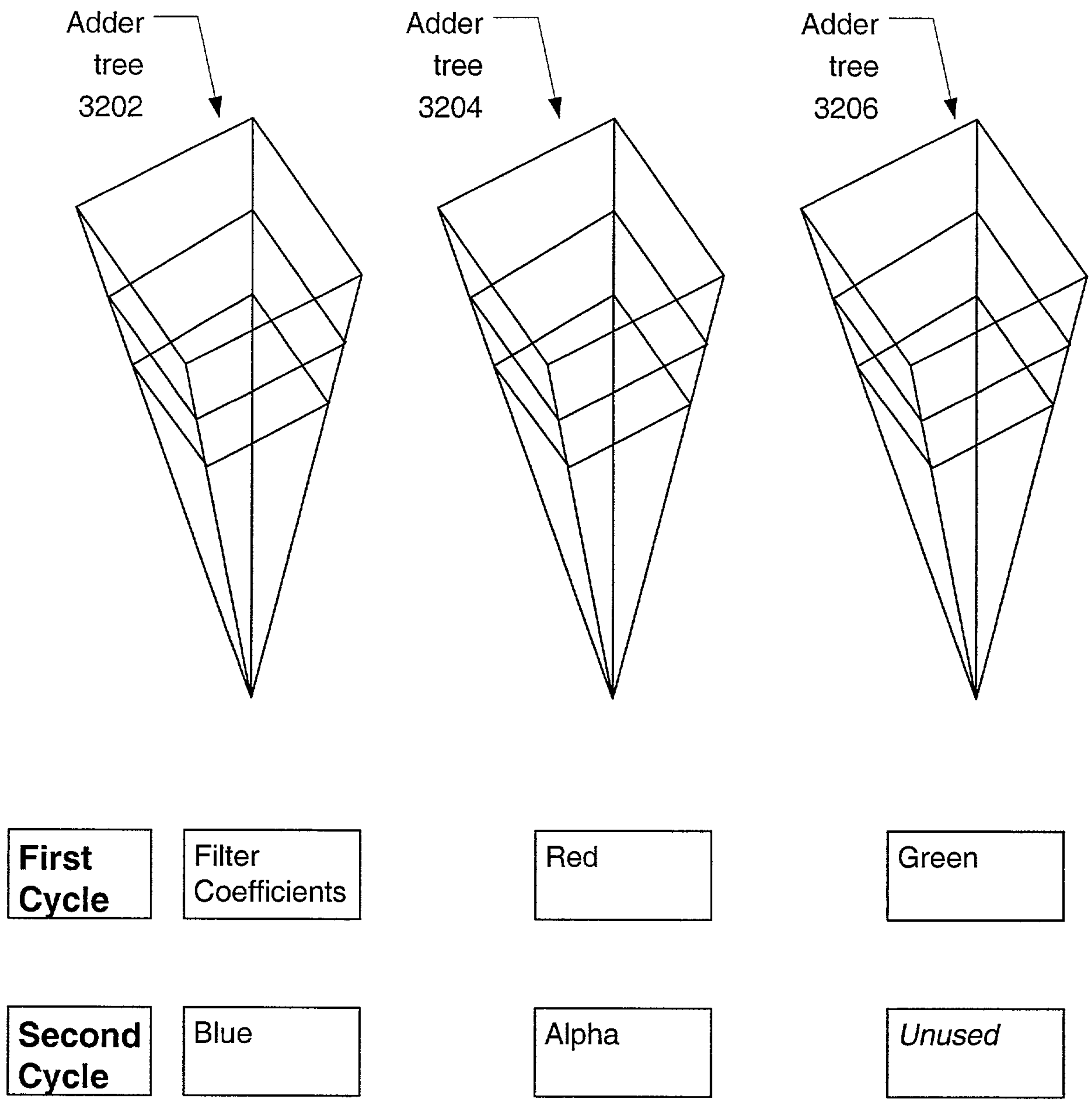

Adder tree 3202
Adder tree 3204
Adder tree 3206
First Cycle
Filter Coefficients
Red
Green
Second Cycle
Blue
Alpha
Unused

Figure 35

$$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2} \qquad \text{Eqn. 10}$$

$$d^2 = (x_1 - x_2)^2 + (y_1 - y_2)^2 \qquad \text{Eqn. 11}$$

Figure 36